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BILATERAL SEGMENTAL VAGAL RESECTION IN THE TREATMENT OF PEPTIC ULCER

A Clinical Study of 50 Cases

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THE widespread interest in vagal resection since Dragstedt introduced the procedure in 1943 is evidence of the crying need for a treatment of duodenal ulcer which is not too radical yet is curative and lasting in its effects. In our experience with the operation, we have been impressed with the number of patients who, having a persistent ulcer, have been unwilling to submit to gastric resection, yet have come to us with the specific intention of having a vagotomy. In accepting patients for this treatment, we have done so with the understanding that its ultimate value remains to be proved. On the basis of present experience, however, we have no hesitancy in recommending the procedure in suitable cases.

Within the past year, we have performed 50 vagal resections. Although this is not a large group, it has enabled us to make several interesting observations in regard to the indications for the operation and its symptomatic and physiologic effects within the period of postoperative study. The procedure has been employed for all types of active duodenal ulcer, with the exception of the acutely perforating and the massively bleeding ulcer during the actual hemorrhage. We have combined gastroenterostomy with vagal resection in the presence of obstruction, whether from severe spasm or cicatrical contracture of the pylorus. In the absence of obstruction, we have employed vagal resection alone. We do not advocate vagotomy without subtotal resection of the stomach for gastric ulcer.

Patients with gastrojejunal or marginal ulcer are particularly suitable subjects for vagal resection. Three of our patients fall into this group. One had had a subtotal gastrectomy four years previously. Since the vagal resection was performed, he has been relieved of his pain, has a good appetite and has gained weight. Two patients had had a gastroenterostomy. Their relief has been complete following vagotomy, and apparently the ulcers have healed. Four others had continued to have difficulty, with evidence of obstruction, subsequent to closure of a perforated ulcer. All four have expressed themselves as being entirely comfortable since the division of the vagi.

Being abdominal surgeons, we have employed the abdominal rather than the transthoracic approach to the nerves. In our opinion, the former has several advantages. First, one may thus visualize the disease process and determine its location and extent. Otherwise, one cannot be sure whether the lesion is on the duodenal or gastric side of the pylorus, and if on the gastric side, whether it is malignant, or, if on the duodenal side, whether it is an ulcer, a duodenitis, or some other lesion. The abdominal approach, moreover, is preferable in that definitive surgery may be performed, if necessary, at the same time and through the same incision. In addition, the patient's convalescence is more comfortable and complications are fewer. According to surgeons who have employed the transthoracic method, pain at the operative site is usually severe for a few days, and some degree of discomfort may persist for several months. Further, they report that pleural effusion and pneumonia are not uncommon.

In using the abdominal approach, the esophagus is easily reached if one first mobilizes the left lobe of the liver by division of its triangular ligament. We have also found it advantageous to leave the stomach tube in situ as a guide. The peritoneum is incised over the lower end of the esophagus, the index finger is passed through the diaphragm, and the esophagus is completely freed from the margins of the hiatus opening and drawn down a distance of about 3 inches. The nerve trunks, which are thus placed under tension, may then be isolated, one on the right posterolateral border of the esophagus, and the other on the left anterolateral border. The trunks are clamped, a section approximately 2½ inches in length is removed from each, and the proximal and distal ends are ligated with fine cotton. Since the upper end retracts into the chest, the two ends are widely separated and thus are not likely to unite.

Before being dropped back into its normal position, the esophagus is explored all around with the finger to determine whether all the

nerves have been resected. No effort is made to close the peritoneal incision over the esophagus.

The right nerve trunk is uniformly much larger than the left. In a few cases, additional bundles may be found on either the right or left, or both. More than 2 trunks have been found in 8 per cent of our cases, though in only one were 4 encountered. It is our belief that only by the abdominal approach can one be sure of finding the large trunks at the extreme lower end of the esophagus.

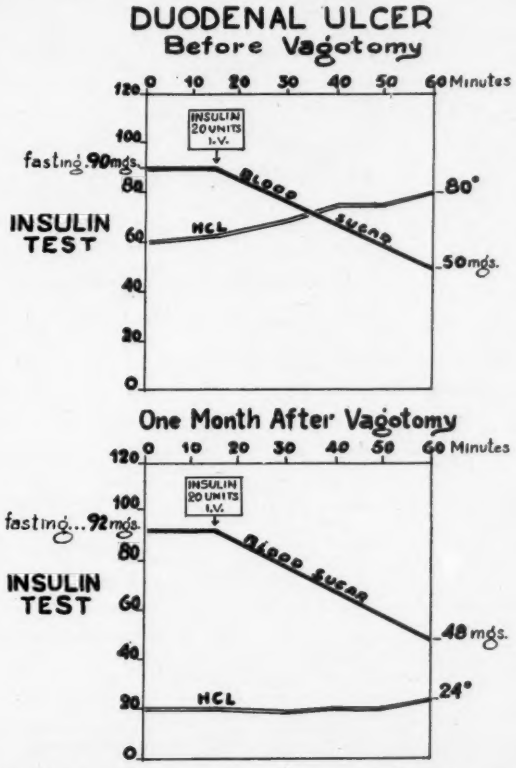

Fig. 1. Diagram showing results of insulin test before and after vagal resection. The fasting blood sugar was 90 mg. per cent; one hour following the administration of 20 units of insulin, it had dropped to 50 mg. per cent. The fasting acids before operation were 60°, whereas under the stimulus of insulin they rose to 80°. The test after operation reduced the blood sugar from 92 mg. per cent to 40 mg. per cent. It will be observed that the fasting acids postoperatively were only 20° (a reduction of 66 per cent), and that they rose to only 24° under insulin hypoglycemia.

In the event a gastroenterostomy or subtotal gastrectomy is indicated, it is our custom to resect the nerves first, while the hand is

sterile, before beginning the attack upon the stomach. If the stomach is opened first, the hand is then contaminated and is likely to introduce an infection into the mediastinum in the subsequent search for the nerve trunks.

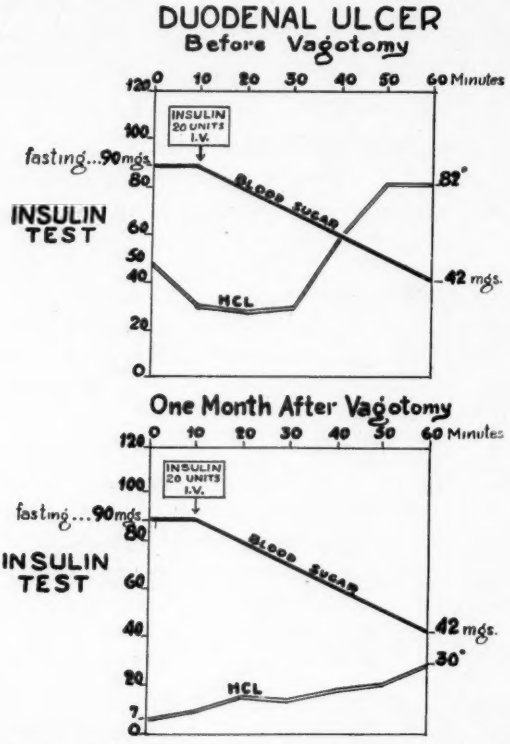

Fig. 2. In this case, the fasting blood sugar of 90 mg. per cent fell to 42 mg. per cent both before and after operation in response to insulin. Preoperatively, the acids rose from 50° to 82°. Following vagal resection, the acids during fasting were only 7°, and after insulin, 30°.

We have employed the insulin test both before and after operation, when possible, to determine the effect of vagal resection upon the quantity and quality of acid secretion of the stomach. Before the operation, the patient is made to fast for a period of 12 hours, and the blood sugar is then estimated. A Levine tube is next placed in the stomach, the patient is given 20 units of insulin intravenously, and the blood sugar and gastric secretion are determined every 10 to 15 minutes. After 30 to 40 minutes, a hypoglycemia may be observed. At the same time, a rise of free hydrochloric acid and combined acids may be apparent from the aspirated stomach contents;

within an hour these may reach an extremely high level. In the typical case, when the test is again applied 3 or 4 weeks after vagal resection, the patient still develops hypoglycemia, yet the gastric acids are not materially increased. In our cases, the post-vagotomy-acids have been reduced 40 to 100 per cent of their former level following an insulin injection (figs. 1 and 2). Such a reaction would

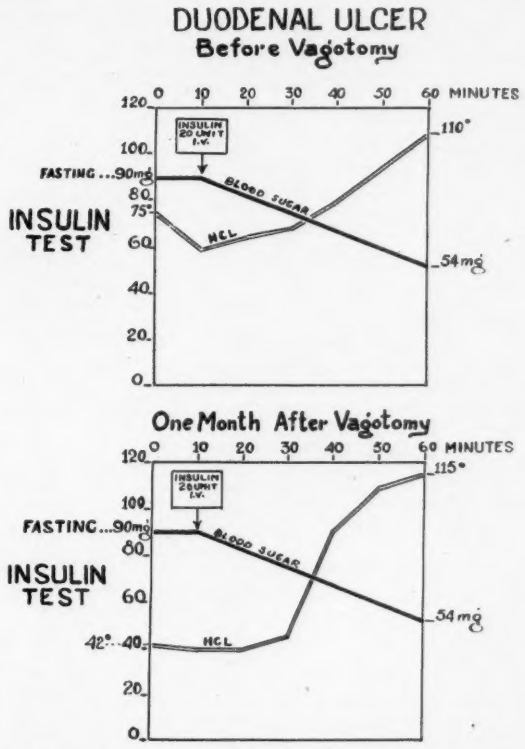

Fig. 3. This diagram shows an atypical curve in gastric acids under insulin hypoglycemia. Before vagal resection, the fasting acids were 75°, while at the end of one hour, they were 110°. After operation, the fasting acids were reduced to 42°, though following insulin they rose to 115°. This was one of 3 patients who had an excessive rise of acids during the hypoglycemic state after operation.

indicate that the hypoglycemic state, through its stimulating effect upon the central nervous system, gives rise to hyperacidity. After the vagi have been severed, the hypoglycemic state continues to stimulate the central nervous system; the pathways having been interrupted, however, the impulses do not reach the acid secreting glands of the stomach and thus there is no hyperacidity.

Granted that the division of the nerve fibers has been complete and that there is no other route for the conveyance of impulses, one would expect the results of the insulin test to be uniform, the acids remaining low in every case under the stimulus of hypoglycemia. This, however, is not always true. The acids of three of our patients were higher in response to insulin following operation than before; despite this, none of the three experienced any pain or other symptoms postoperatively. Two of the three had a gastroenterostomy in conjunction with vagal resection. An outstanding case was that of a traveling salesman, aged 43, who had a vagal resection and gastroenterostomy for a penetrating ulcer. Before operation, his fasting free acids were 75° and after insulin, 110°. Following vagal resection, he was promptly relieved of his pain, vomiting and fullness, and on leaving the hospital, was taking a regular diet without discomfort and was gaining weight. Four weeks postoperatively, the roentgenogram showed evidence of beginning healing of the ulcer. His fasting free acids at this time were 42°, and one hour after insulin they were 115° (fig. 3). It is significant that the fasting acids were reduced from a preoperative level of 75° to a post-vagotomy level of 42°.

The fact that the symptomatic relief of these patients remained constant shows that interruption of the vagal impulses to the stomach controls symptoms, even though the acid response to insulin hypoglycemia may be excessive. From this, it seems likely that the chief secretory factor in the development and maintenance of duodenal ulcer is the production of excessive amounts of acid during periods of fasting, as Dragstedt pointed out in his early work on this subject.

On the whole, we have thus far been most pleased with our results of vagal resection. Patients are immediately relieved of pain and other distressing symptoms and, in fact, report a sense of perfect comfort and relaxation of the stomach. On leaving the hospital, they are taking a full diet, the stomach is emptying satisfactorily, and an improvement in appetite and digestion are accompanied by a beginning gain in weight and a sense of mental as well as physical well-being. We have had no hospital fatalities. Roentgenograms have not been possible in every case, but those obtained have shown a decrease in tone and motility of the stomach, with evidence of healing of the ulcer, and the intestinal pattern has been normal (fig. 4). Only three patients have presented exceptions to these results.

One patient was relieved of his pain following vagal resection,

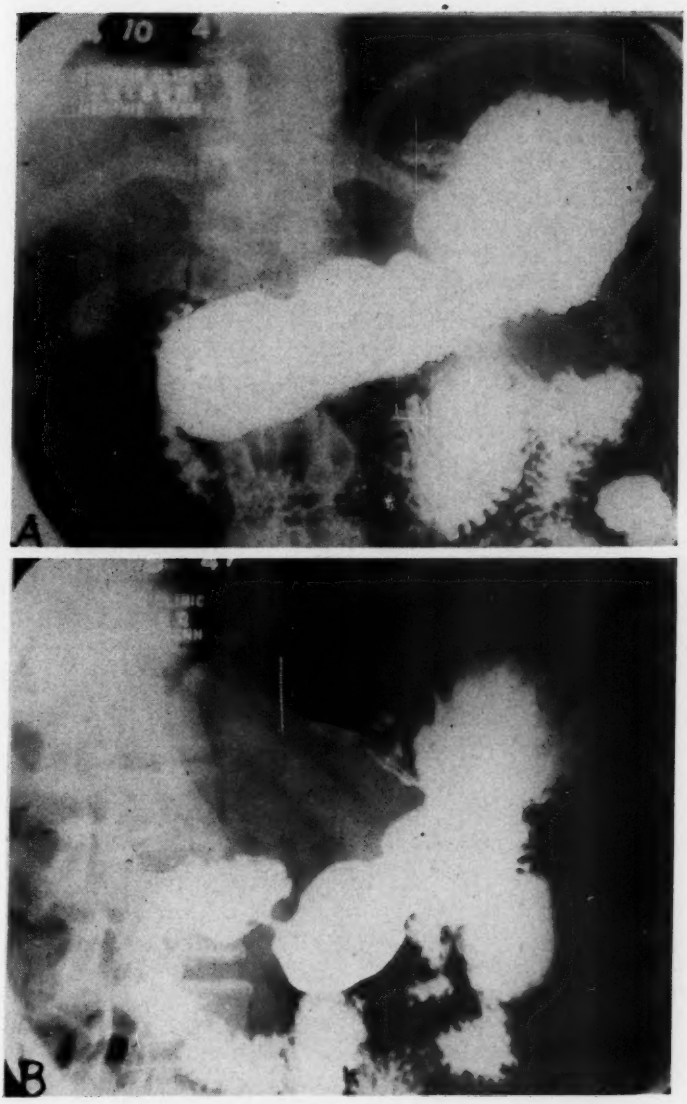

Fig. 4. (A) Preoperative roentgenogram of obstructing duodenal ulcer with diminutive cap and large stomach. (B) Four weeks later; cap well filled; evidence of rapid healing of the ulcer; stomach reduced in size and function normal.

though his stomach was extremely atonic and he was troubled with eructations of foul gas. Despite the fact that decompression was

employed for 4 days, he was only temporarily relieved, and 10 days after his discharge from the hospital, he returned on account of distention. Again, the stomach tube was used for 4 days, and at the same time, the patient was started on Urecholine. The gastric tone promptly improved, and so long as the Urecholine was continued, he was quite comfortable; as soon as the drug was omitted, however, his stomach again became distended and the gaseous eructations returned (figs. 5, 6, 7). For this reason, a gastroenterostomy was performed. Thereafter, his stomach function promptly became normal and he has since been free of all his former distress.

We have had one other patient who has had considerable difficulty because of gastric atony following vagal resection alone. He was relieved of pain, though 3 months later still complained of gas, and the roentgenogram showed a 3 hour retention of three fourths an ingested meal. He seems to be slowly improving while taking Urecholine, and is able to work regularly.

Another patient continues to have epigastric distress and sour brash 4 months following vagal resection. Instead of retention, however, his stomach is excessively spastic and empties rapidly. Strangely, this patient's relief was complete until he was given an insulin test, though his acids were 55° at the height of insulin hypoglycemia after operation, whereas before they had been 108°.

These 3 patients have been the only ones who have suffered any serious and prolonged postoperative disturbance. A few others, however, have reported a mild but transient sense of fullness after meals, incident to diminished gastric tonus.

The immediate effect upon bowel function has been that of increased activity. A considerable number of patients have had from one to three movements daily for several days. One had ten to twelve stools daily, though this subsided before he left the hospital on the eleventh day. Many have been relieved of a troublesome constipation, having had one or two movements on the second day, without the use of an enema. One, who previously had been chronically constipated, had two or three movements every day during his entire stay in the hospital. Only two have continued to require laxatives, though not so often as before operation. In the majority of cases, bowel function has been perfectly normal.

In one case, a bilateral vagal resection was done as a preliminary to subtotal gastrectomy, presumably for a benign ulcer. When the stomach was removed, however, the ulcer proved to be malignant. The vagal resection would have been omitted had not the ulcer presented every appearance of a benign lesion, yet it is noteworthy that

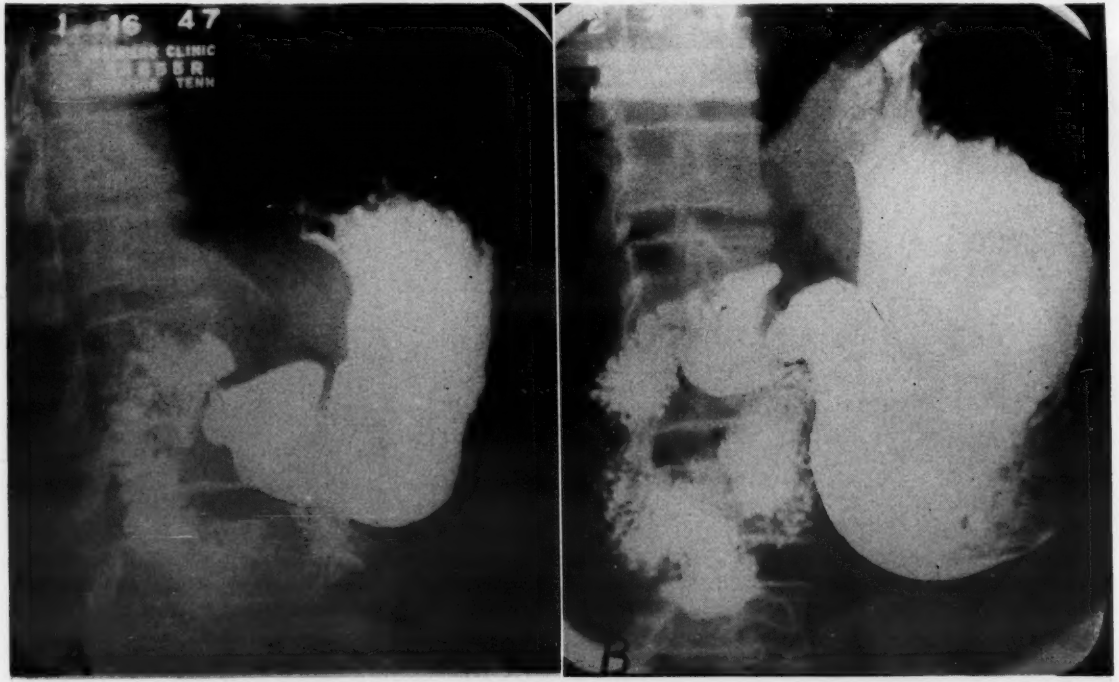

Fig. 5. Unusual case. (A) Stomach before operation. (B) Stomach two weeks after operation, showing extreme atony and poor emptying. The patient complained of a sense of fullness and gaseous eructations. Apparently, the vagotomy was complete, practically all motor function having been lost.

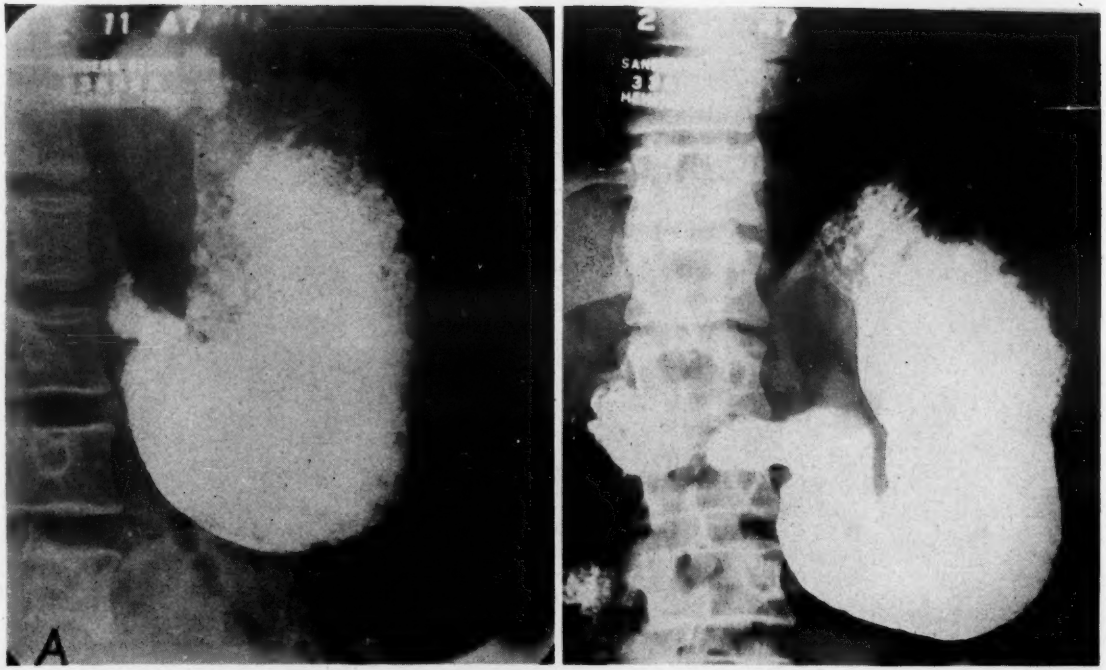

Fig. 6. Same patient as in Fig. 5. (A) Three weeks after operation. The atony has increased and the stomach empties still more slowly. (B) The patient has begun taking Urecholine and the stomach function is improving.

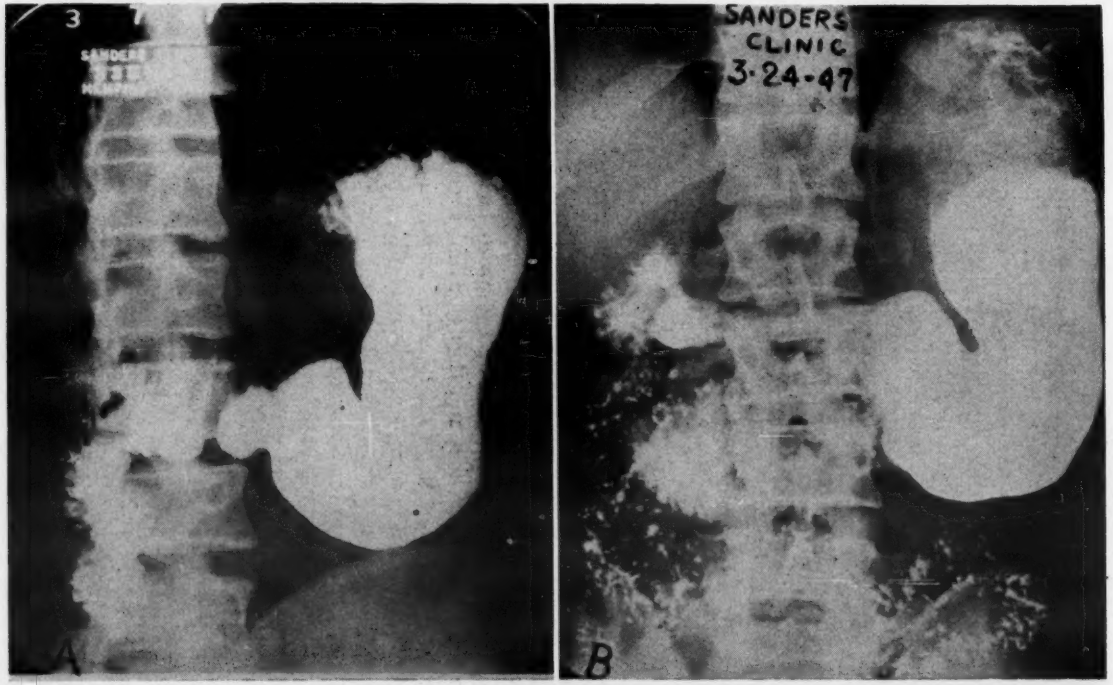

Fig. 7. Same patient as in Figs. 5 and 6. (A) The size of the stomach is reduced still further and function has materially improved after three weeks of Urecholine medication. The patient was comfortable so long as he continued the use of the drug, but as soon as it was discontinued his symptoms returned. (B) Beginning distention after medication was stopped. A gastroenterostomy was done and the patient was promptly relieved.

the patient's recovery was exceptionally smooth and comfortable, and his home physician writes that his further progress has been more satisfactory than that of any patient whom he has ever observed with a similar condition.

Three of the patients in this group had no definite ulcer, but did have a severe duodenitis, while two others had both duodenitis and a small ulcer. All these five patients gave a history of ulcer symptoms over a period of several years, and all had the clinical and roentgenographic evidences of an active lesion. After vagal resection, they experienced the same immediate relief of symptoms as those with a frank and active ulcer.

Incidentally, the finding of a duodenitis instead of an ulcer in these cases illustrates the advantage of the abdominal approach. Had the operations been performed through the thorax, the diagnosis of duodenal ulcer would have remained unquestioned, especially in view of the symptomatic relief which has followed.

Our experience does not justify any conclusions regarding the permanence of the symptomatic relief or healing of the ulcer following vagal resection, though Dragstedt and others who have been using the precedure for 3 or 4 years are enthusiastic over their results. Unquestionably, in the typical case the immediate and complete cessation of symptoms is phenomenal and, if lasting, is alone sufficient to commend the treatment to patients with an intractable or recurrent ulcer. It is likewise advantageous in that patients are able to follow a normal diet and thus to avoid anemia. Again, the technic is relatively simple in the hands of the experienced surgeon, recovery is rapid, and the mortality is negligible. In these respects, the operation is obviously preferable to subtotal gastric resection. Finally, we are safe in the knowledge that, if we should be found to have erred in performing vagal resection, it will have been on the side of conservatism, and gastroenterostomy or subtotal gastric resection may be undertaken, if necessary, at a later date.

PERIPHERAL ARTERIAL OCCLUSION

Report of Successful Surgical Treatment of Occlusion of the Brachial Artery More Than 36 Hours after Onset of Symptoms

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OCCLUSION of a peripheral artery by a thrombus or embolus, especially one of the major arteries to an extremity, is a serious problem, difficult to treat, and often leading to gangrene of the affected limb and a possible fatal outcome. It is generally agreed that the time element is perhaps the most important single factor affecting the prognosis in these cases, and it is with this in mind that the case report to follow is presented.

Cornell[1] makes an arbitrary time limit of 6 hours within which time a successful embolectomy may be performed, and he further states that after 6 hours thrombosis, ulceration, and infection of the intima of the artery will preclude any possibility of reestablishing the circulation in the affected vessel, even if the embolus is removed.

De Takáts[2] states that not more than 10 hours should have elapsed before surgery is done if the result is to be a successful one. He states in addition, however, that with the advent of heparin it may well be that emboli 24 hours old may be successfully extracted. Finally, de Takáts states that statistics show that restoration of the circulation does not occur after 24 hours, but if operation is done in the first 10 hours approximately 40 per cent show reestablishment of the circulation.

Duncan and Myers[3] point out that brachial embolism gives a better prognosis than embolism in other parts of the body, but still carries with it a percentage of failure in the neighborhood of 60 per cent or more.

It is beyond the scope of this presentation to consider in detail the sympomatology and diagnosis of arterial embolism, and one certainly could not improve upon the works of de Takáts and Cornell in their reviews of the subject. The predominant symptoms are: premonitory symptoms, such as shooting pains, numbness or coldness of the extremity, followed by paralysis, numbness and agonizing pain. The color of the extremity is pallid, later mottled or cyanotic. Arterial pulsations are not felt.

Report of Case

R. J. F., white male, 58 years of age, was admitted to St. Joseph Hospital on Nov. 25, 1946. He complained of pain in his left upper extremity of approximately 36 hours' duration and becoming progressively worse. The history of the exact mode of onset was vague, inasmuch as the patient had been on an alcoholic spree of about one week's duration just prior to the onset and he could not remember details. He thought possibly he had rested his arm on the back of a chair for a long period of time. The pain involved the entire upper extremity but was worse in the hand and wrist. Past history was non-contributory.

Physical examination revealed a well developed and nourished 58 year old white male, apparently in some pain, somewhat lethargic and slow mentally. The blood pressure was 184/100. The heart rate was 72. There was slight left-sided cardiac enlargement. The examination was otherwise essentially negative, except for the left upper extremity. The left hand and forearm to a point approximately 4 inches above the wrist was cold and presented a peculiar bluish cyanotic pallor, fairly sharply demarcated at its upper limit. The patient was able to move his fingers but there was marked weakness. The radial pulse was absent. The axillary artery pulsation was palpable in the lower axilla but stopped suddenly just above the point of origin of the brachial artery, and a firm tender streak, apparently a thrombus, was felt throughout the length of the brachial artery. Routine laboratory work, including blood counts and urinalysis, was essentially normal. Electrocardiogram revealed findings indicative of left axis deviation. A diagnosis of occlusion of the brachial artery, probably by an embolus, was made. A procaine block of the stellate ganglion produced no appreciable change in the appearance or temperature. It was believed by all who saw the patient that the prognosis for saving the hand was poor and probably hopeless. However, in view of the fact that the patient could still move his fingers some and that the preservation of his hand was most desirable and important to him in his work as a moulder, the decision to explore the artery and attempt removal of the obstruction was made.

Operation was done under cyclopropane anesthesia about 9 or 10 hours after admission to the hospital, or about 45 hours after onset of symptoms. A long incision was made on the medial aspect of the arm over the artery; exposing the vessel from the origin of the brachial to its bifurcation and approximately 3 or 4 cm. beyond. In this particular case the bifurcation was found to be at a higher level than usual, lying a short distance above the elbow. Inspection and palpation of the exposed artery revealed a firm thrombus filling the lumen from the origin of the brachial through the bifurcation as far down both radial and ulnar branches as could be felt. After placing a small Penrose drain around the vessel above the level of the thrombus and around each of the terminal branches at the lower end of the wound in such a manner as to control bleeding by lifting and tightening the loop around the artery, an incision about 2 cm. long was made over the upper part of the thrombus. A long firm clot was removed from the lumen of the vessel by suction and forceps. The clot was moderately adherent to the intima of the artery. As it was removed the suction tip passed down the terminal branches almost half way down the forearm. The arterial incision was closed with continuous suture of fine arterial silk and covered by a small piece of gelfoam. The wound was closed anatomically.

The immediate postoperative condition was fair. The color of the hand was considerably improved; however, the radial pulse was not palpable. The patient received heparin intravenously in continuous saline drip for 2 days after operation and dicumarol by mouth, 200 mg. the first day and 100 mg. daily thereafter for 4 days. On the 2nd postoperative day the stellate ganglion was injected with 5 c.c. of intricaine in oil and 3 c.c. of the same substance injected in the vicinity of the seventh cervical and second and third dorsal nerves by Dr. Max Hughes. The resulting prolonged sympathetic block appeared to aid materially in increasing the circulation to the part. The postoperative course was one of progressive improvement and when discharged from the hospital on December 4, the 9th postoperative day, the color of the hand was normal, sensation was good, and there was no complaint except for tingling sensations in the hand and lower forearm at times. The patient was seen 17 days after discharge from the hospital and the appearance and function of the hand were normal. The radial pulse was still not felt.

SUMMARY

1. A few pertinent facts from the literature relative to peripheral arterial occlusion are reviewed.

2. A case of occlusion of the brachial artery successfully treated by operation performed approximately 45 hours after the onset of symptoms is reported. In this instance it seemed impossible to differentiate between embolism and thrombosis, even after operation. The most unusual feature of this case was the successful treatment after the lapse of such a long period of time. The operation was done more or less in desperation and little hope was held for recovery without amputation prior to operation.

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UROLOGIC COMPLICATIONS OF PELVIC FRACTURES

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ACCORDING to Speed[1] fractures of the bony pelvis account for 0.6 per cent of all fractures and may be as high as 3 per cent in some localities. Injuries to the urinary tract are the most frequent and the most serious complications. These complications are estimated to occur in from 7 to approximately 40 per cent of cases.[3-6,8,9,16-24] In a series of 780 fractures of the pelvis McCague and Semans[5] report 23 per cent mortality from urinary complications. One of the common complications is ruptured bladder and Campbell[6] had 64 per cent fatalities in patients with rupture of the bladder from various causes. During a 6 year period (June, 1940 to June, 1946) 126 patients with fractures of the pelvis were treated at the John Gaston Hospital, Memphis, and in these there were 30 cases, or 24 per cent, with urologic complications.

Fractures of the pelvis have become more and more frequent with the advent of the automobile and the airplane. Industrialization also has changed this phase of medicine as it has changed many others in recent years. In 1849 Malgaigne[2] stated that pelvic fractures were an unusual entity and he had seen no complicating injuries. Thirty years ago 4 per cent of ruptured bladder cases were due to vehicular accidents[6] and 15 years ago Noland and Conwell[8] found 35 per cent of pelvic fractures were due to this cause. Vehicular accidents caused 73 per cent of this series of 126 cases. Furthermore, many pelvic fractures and urologic complications remain undiagnosed when they occur in conjunction with other and fatal injuries. Most pelvic fractures are the result of direct trauma, such as heavy blows or severe crushing injuries.

Formerly males suffered pelvic fractures about four times as often as females but casualties on the highway sometimes result in the female pelvis being fractured about as often as the male.[1,16] It is stated that the broader, lighter female pelvis may be broken with less violence than that of the heavier, tighter bound male pelvis.[1] In our series there were almost twice as many males with pelvic fractures and three times as many urologic complications in males as in females (Table 1). Fracture of the pelvis occurs more often

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in the younger age groups. We found an average of 38 years and for the group with urologic complications the average age was 35 years. The majority of emergency cases treated at the John Gaston Hospital are negro patients. It is interesting to note that 70 per

TABLE 1

	Complicated Pelvic Fractures	Uncomplicated Pelvic Fractures
	AGE	
Youngest	9	6
Oldest	84	79
Average	35	38
	SEX	
Male	22 (27%)	58 (73%)
Female	8 (18%)	38 (82%)
	RACE	
White	3 (10%)	30 (30%)
Negro	27 (90%)	66 (70%)

cent of the uncomplicated pelvic fractures in this series were in negroes, whereas 90 per cent of the complicated pelvic fractures were in negroes.

The usual cause of pelvic fracture with urologic complications is direct trauma of great violence. Twenty-five of the 30 fractured pelves (83 per cent) with these complications were multiple. In 73 per cent of the uncomplicated cases the fractures were multiple (Table 2). Inasmuch as the pelvis can spring back into place after separation of the sacro-iliac joints or symphysis pubis the degrees of fracture and of displacement found after accident may not truly represent the actual extent of the injury.

There were 11 deaths (37 per cent) in the complicated cases. Of these, there were 3 ruptured urethras, 2 ruptured bladders, 1 hematoma of the bladder, and in 5 a diagnosis of hematuria of undetermined origin. Three of these patients died shortly after admission to the hospital. There were 6 deaths (6 per cent) in the uncomplicated pelvic fractures (Table 3).

In this series there were 29 cases (23 per cent) with hematuria.

The one patient with urologic complication who did not pass blood had a hematoma of the bladder. Noland and Conwell[4] state that 42 per cent of their cases of pelvic fracture had hematuria. Eleven cases of ruptured urethra were encountered; 2 of these occurred

TABLE 2

	Complicated Pelvic Fractures	Uncomplicated Pelvic Fractures
	CAUSE OF INJURY	
Vehicular accident	24 (80%)	68 (70%)
Falls		21 (23%)
Compression injuries	4 (13%)	5 (5%)
Gunshot wounds	2 (7%)	2 (2%)
	DEGREE OF FRACTURE	
Multiple fractures	25 (83%)	58 (60%)
Single fracture	5 (17%)	38 (40%)

when the patient with a fractured pelvis turned suddenly in bed. There were 5 patients with ruptured bladders, 1 intraperitoneal and 4 extraperitoneal. At operation 2 patients were found to have hematomas of the bladder and there were 2 contusions of the bladder. Two patients had contusions of the kidney. In 8 cases with hematuria the source of bleeding was not definitely determined.

In analyzing this series and in our personal experience it has been found that most patients treated at a municipal charity hospital do not know exactly how or where, anatomically, they were struck. Many of these patients were walking down a road at night or were violently crushed in an automobile accident and were in shock when they arrived at the hospital. All of these factors reduce considerably the likelihood of an accurate history. It is a well known fact that the bladder is more easily ruptured when full as it arises from the true pelvis and is exposed and vulnerable to abdominal trauma even in the absence of pelvic fracture. This is true especially in an intoxicated individual, who may be oblivious to any desire to urinate and therefore allows his bladder to distend. Campbell[6] states that approximately one third of all vesical ruptures occur when the patient is intoxicated. Unfortunately we were unable to elicit accurate histories of whether the patient's bladder was full at the time of accident and no accurate data were kept as to the patient's state of intoxication.

Urethral Injuries

These injuries with few exceptions result from direct blows on the perineum forcing the urethra against the pubic arch, gunshot wounds, or fracture of the pelvis, usually the pubic arch. In this series there were no urethral injuries caused by direct trauma to the perineum or the so-called straddle injuries. Injuries to the urethra may consist of simple abrasions, contusions, interstitial rupture of the urethra without loss of continuity, partial rupture without loss of continuity, complete separation of the divided ends of the urethra, and evulsion of the urethra.[27]

TABLE 3

	Complicated Pelvic Fractures	Uncomplicated Pelvic Fractures
	Fatalities	
Deaths	11 (37%)	6 (6%)
	Type of Injury	
Ruptured urethra	3	
Ruptured bladder	2	
Hematoma of bladder	1	
Not known	5	

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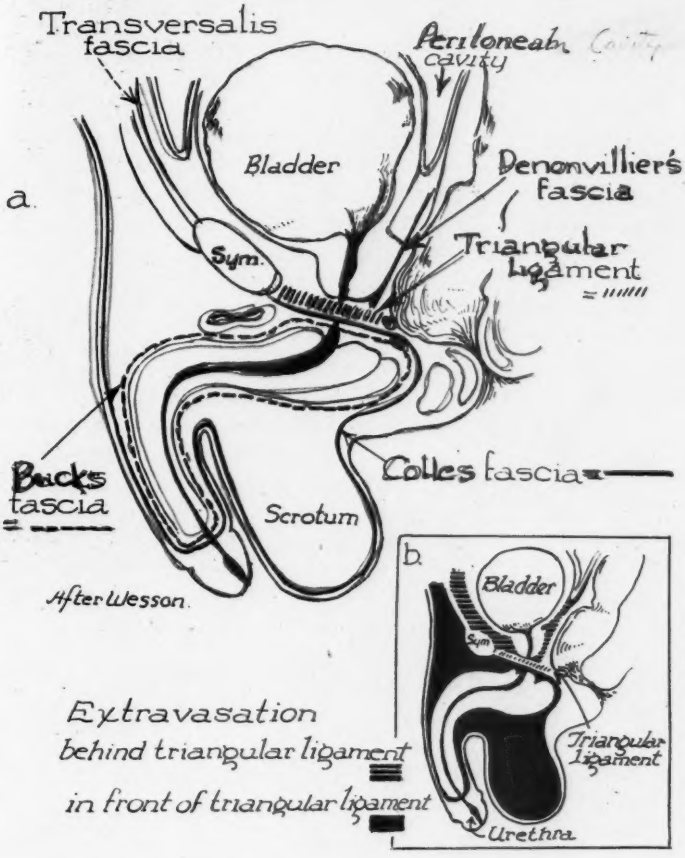
Of particular importance is the relation of the site of rupture to the triangular ligament; that is, whether it is anterior, within, or posterior to that ligament. These factors determine the course of extravasation, symptoms, signs, treatment, and prognosis (Diagram I). Extravasated blood and urine is directed and controlled by the layers of the triangular ligament and Colles' fascia. The superficial perineal space (Colles' pouch) is formed by the attachment of this fascia to the lower part of the ischiopubic rami. Anteriorly Colles' fascia spreads over the scrotum and penis to unite at length with Scarpa's fascia. When the bulbomembranous urethra is injured the blood and urine extend beneath Colles' fascia filling the superficial perineal pouch. The extravasated urine is prevented from extending to the thighs by the density of the fascial layers beneath Poupart's ligament. From the superficial perineal pouch it extends anteriorly beneath the dartos of the scrotum and penis and up over the abdomen beneath Scarpa's fascia. Hence these areas should always be drained when there is extravasation of urine and

blood. When the injury is in the pendulous portion of the urethra, extravasation is usually limited to the penis by Buck's fascia. Ruptures between the layers of the triangular ligament result in a localized abscess which in turn ruptures in front of or behind the ligament. Extravasation from the posterior urethra occurs proximal to the triangular ligament and extends upward into the perivesical space posteriorly to the diaphragm limited below by Denonvilliers' fascia. The deep position of extravasation makes it difficult to recognize and drain a collection, hence in this location extravasation has a much higher mortality rate. There may be ecchymosis of the perineum without extravasation of urine unless the injury is so severe that the anterior layer of the triangular ligament is torn. Simpson-Smith[9] states that expectation that the extravasation will follow closely the confines of fascial planes may be erroneous when severe trauma such as is present in pelvic fractures has been sustained. Generally injuries resulting from a blow on the perineum involve the bulbous urethra while injuries from pelvic fractures affect the membranous and prostatic urethra.

The patient with a ruptured urethra is usually in some degree of shock and complains of severe pain in the perineum and suprapubic region. If the injury is anterior to the sphincter there is bleeding from the external urethral meatus and all of the patients in our series had urethral bleeding. Attempts to void may be successful when the tear is incomplete, or an attempt to void may be accompanied by severe pain in the perineum from extravasation, with no urine appearing at the meatus. Although there were no complete ruptures of the urethra in this series none of the patients was able to void following injury. Cases have been reported[10,11] in which clear urine was passed for several days before the patient developed retention. In some cases the first attempt to void was successful but thereafter peri-urethral swelling from extravasation and edema produced obstruction.

A rectal examination should be done on all patients with pelvic fracture. The examining finger may reveal the brawny induration of a perivesical phlegmon or that the apex of the prostate is sheared away from the bulbous urethra. The most commonly employed, and also the most undependable test for ruptured urethra, is having the patient attempt to void and if he is unable to void, attempting catheterization.[9] Passage of a catheter is usually impossible except in injuries or contusions of mild degree. If the rupture is proximal to the triangular ligament the catheter may pass into the perivesical space and the draining of pure blood may lead one to believe that the bladder is ruptured. If passage of a catheter is possible a cysto-



gram may be done and an attempt to determine whether the bladder has been injured; then the tip of the catheter is withdrawn into the urethra and a urethrogram made to determine if extravasation has occurred around this area. Such radiopaque media as skiodan or diodrast are satisfactory for this purpose. Usually reliable differential points in the diagnosis of ruptured urethra and ruptured bladder are that in the former there is blood at the urethral meatus and the bladder is full and in the latter no blood is present at the meatus and the bladder is empty.

The objectives in the treatment of ruptures of the urethra are: adequate drainage of the bladder, prevention or drainage of extravasation of urine, and re-establishment of the continuity of the ure-

thra.[15] Orthopedic correction of the pelvic fracture is of secondary importance to the early diversion of urine from the injured urethra. If one is certain that there is only a minimal tear of the urethral mucosa without signs of extravasation, insertion of an inlying catheter for hemostasis and drainage is the only treatment indicated. This was the method of treatment in 4 of our cases. Strict aseptic precautions should be employed and a careful watch kept for evidence of infection or delayed extravasation. The employment of chemotherapy and antiseptics is of definite value in the prevention and treatment of infection. When the urethra is extensively torn or completely severed or when extravasation of urine has occurred, prompt diversion of urine by suprapubic cystostomy and drainage of the extravasated areas are imperative. In 7 of the cases with extensive laceration of the urethra with extravasation, the suprapubic approach to the urethra was employed. In our opinion, urethrostomy is impractical, if not dangerous, immediately after the injury because of the hazard of causing more extensive damage by the fractured pelvic bone while manipulating the patient into the lithotomy position. As was mentioned above, 2 of our cases sustained ruptured urethras while turning in bed. If further surgical correction of the urethra by the perineal approach is indicated a period of 4 to 6 weeks should be allowed to elapse during which time the fracture has had time to mend. After the urethral catheter is removed the retrograde passage of a catheter is carried out in order to avoid dense fibrosis which may later prevent or render impossible the establishment of a normal urethral lumen. If the patient is in good condition and multiple comminuted fractures or loose fragments of bone are not evident on x-ray examination, the continuity of the urethra should be restored and a urethral catheter left in place to prevent extensive stricture during the healing period. Insertion of a catheter can usually be accomplished without opening the urethra. If a portion of the urethra is intact a catheter can sometimes be passed retrograde. If this is impossible, two Van Buren sounds are passed, one through the urethra and one retrograde, and by careful manipulation the points may be brought together. The point of the lower sound is then guided into the bladder as the upper sound is removed. The fluted end of a Coudé catheter is fitted snugly over the lower end which is slowly and carefully withdrawn, carrying the catheter through the urethra where it is tied in place, or if preferred the tip of a Foley catheter of suitable caliber can then be attached to the distal end of the Coudé catheter and drawn through the urethra. As a rule the latter is a more satisfactory retention catheter with less likelihood of maladjustment or accidental removal. When the urethra is completely sev-

ered, the upper end is carried upward and backward and to correct this the prostatic urethra must be brought downward and forward into apposition with the lower fragment. No cases of complete separation of the divided ends of the urethra were encountered in our series. Reynolds[7] reports splendid results by using a Foley catheter to pull the base of the bladder to its normal position and splint the urethra. Tension is maintained, which pulls the base of the bladder downward and approximates the two ends of the urethra. The cavity produced by extravasation of blood and urine is also partially obliterated. A suprapubic catheter is secured in the bladder for additional urinary drainage and a rubber tissue drain inserted into the prevesical space. The suprapubic catheter may be removed on the tenth postoperative day and the urethral catheter left in place for approximately 3 weeks. At the end of this time urethrograms are taken to determine the condition of the urethra.

Bladder Injuries

Fracture of the pelvis is the most frequent single cause of bladder injury. Dodson[15] states that approximately 20 per cent of pelvic fractures are complicated by ruptured bladders. This is one of the most deceptive conditions encountered in surgical practice. It is often overlooked or misdiagnosed and accounts for many needless fatalities. Campbell[6] reports 73 per cent mortality in intraperitoneal rupture and 43 per cent in extraperitoneal rupture. Injuries accompanying pelvic fractures are most often extraperitoneal;[4,23] however, Campbell[6] found two thirds of his patients had intraperitoneal ruptures. In this series there were 4 patients with extraperitoneal rupture and one with intraperitoneal rupture. In 2 cases the bladder neck was the site of injury, in one the posterior wall was torn and in one the anterior wall of the bladder was sheared away. The intraperitoneal rupture was high on the posterior wall of the bladder. Laceration of the bladder wall in pelvic fractures is usually caused by disruption of the pelvis with exertion of sudden force on the fibrous attachments of the bladder. Occasionally the bladder is punctured by the sharp ends of bony fragments. Rupture of the bladder, one intraperitoneal and one extraperitoneal, was the cause of 2 deaths. In the former the patient was operated on within 8 hours but died 2 days postoperatively of peritonitis. The patient with extraperitoneal rupture was operated on within 24 hours of the injury and died 3 days later of peritonitis from an intestinal perforation.

Every patient with a fractured pelvis should be carefully observed for evidence of bladder injury. If voiding is painful, diffi-

cult, or impossible, or if the urine contains blood, the condition of the bladder must be determined. The patient is usually in shock and has the appearance of one who is suffering from internal hemorrhage. Low abdominal pain is the rule and examination reveals rigidity of the lower abdominal muscles. There may be a palpable mass in the suprapubic region. Evidence of peritoneal irritation is present in intraperitoneal rupture. It should be emphasized that a rectal examination should be done in all cases of suspected injury of the urinary tract. In addition to determining the condition of the prostate it may reveal a boggy mass in the region of the base of the bladder resulting from an accumulation of extravasated blood and urine. As in suspected ruptured urethra, the most commonly employed and the most inaccurate test for rupture of the bladder is that of catheterization. Blood rather than urine may be obtained. Clots may plug the catheter. Injection of a known amount of fluid and measurement of the quantity returned may lead to an erroneous conclusion. The rent in the bladder may be so small that approximately the same amount of fluid is recovered as was injected; also bladder spasm may seal the opening. Large amounts of bloody fluid may be withdrawn from the peritoneal cavity when there is a large intraperitoneal rent in the bladder. On the other hand, a loop of intestine may occlude the opening in the bladder.[16] Campbell[6] found that in 41 patients with rupture of the bladder the catheter test was of diagnostic value in only 13 cases. If injury of the bladder is suspected a cystogram should be made at the time the roentgenogram is taken to determine the presence or extent of the osseous fracture. Extravasation of the contrast media into the perivesical area definitely indicates rupture of the bladder, although the cystogram may appear normal even in the presence of rupture. Cystograms were made in 3 of our cases of vesical rupture. This examination apparently was not conducted in the other 2. The employment of cystoscopy is to be discouraged in the management of ruptured bladders. Bleeding may be so profuse that visualization of the bladder is obscured or impossible. A real danger is lifting and manipulating the patient into position for examination, thus possibly causing further injury by the fractured pelvis. There is also a possibility of disseminating infection. An excretory urogram is a very useful procedure in determining if the bladder is ruptured as well as determining the condition of both kidneys, providing the patient is not in shock. If the patient is in shock the contrast media is not excreted in sufficient quantity to be of diagnostic value.

Rupture of the bladder is a surgical emergency and immediate operation is necessary in all cases unless the patient is in shock. If

shock is present it is strenuously combated and when the patient has responded the surgical procedure is carried out. General anesthesia is the anesthetic of choice. If the patient's condition is poor and intraperitoneal rupture is not suspected, regional block and local infiltration of procaine may be employed satisfactorily. Because of past, present, or probable shock, spinal anesthesia should be employed with great caution, if at all.

If an intraperitoneal rupture is suspected, the suprapubic incision should be of sufficient length to permit exploration of the peritoneal cavity before the bladder is opened. If bloody fluid is present in the peritoneal cavity a laceration probably will be found in the peritoneal covering of the posterior bladder surface. The urine and blood should be sponged or aspirated from the cavity and the peritoneum closed. The anterior surface of the bladder is then opened and the interior carefully inspected for possible further injuries and the bladder drained suprapubically. In extraperitoneal rupture, institution of drainage is the chief objective. When the prevesical space is opened there is usually a profuse drainage of blood and urine. The bladder is opened and a careful inspection made of the interior. If the laceration is small or difficult to expose, no effort should be made to close it as the wound will heal with suprapubic drainage. If there is an extensive laceration, easily exposed, the margins of the wound are approximated with #1 plain catgut as a continuous suture. The prevesical space should be drained adequately. Suprapubic drainage may be discontinued after a minimum of 10 days and urethral catheter drainage instituted for several additional days which will hasten closure of the suprapubic sinus.

Contusions and hematomas of the bladder are generally not discussed in textbooks of surgery and are seldom referred to in articles discussing urologic injuries. They probably occur more frequently than is generally assumed. Symptoms usually noted are suprapubic pain, hematuria, painful frequent urination and obstruction to the flow of urine by clots. Large quantities of blood may be lost from extravasation from the contused vesical wall. Hemorrhage can usually be controlled by evacuation of clots and putting the bladder at rest by catheter drainage, which should be maintained until several days after bleeding has ceased.[14] There may be great difficulty in definitely excluding an actual rupture of the bladder in cases of contusions and hematomas of the bladder. When in doubt a suprapubic exploration is a proper and justifiable procedure because of the serious import of allowing an extravasation to go unrecognized and untreated. Jones[30] reported a mortality of only 11 per cent in

patients operated on within 24 hours and 55 per cent mortality in patients operated on after 24 hours. In Bacon's series[31] there was 90 per cent mortality in ruptured bladders not operated upon; only 37 per cent mortality in those cases in which surgery was performed.

Late Complications and Their Prevention

Injury to the urethra is often followed by extensive stricture formation. Following removal of the urethral catheter, dilatation is begun after one week and continued at gradually increasing intervals until there is no evidence of further contraction of the stricture. After this the caliber of the urethra is checked at least once yearly.

There is a tendency for calculus formation to occur following pelvic fractures with urologic complications. Flocks,[27,28] Keyser,[29] McCague[12] and numerous others have stated that the recumbency enforced by fractures in general predisposes to formation of urinary stones and this is especially true when the patient is immobilized with a pelvic fracture. In addition to recumbency, infection, stasis of urine, and injury to the epithelial lining of the urinary tract are other important factors which would arouse surprise that stone formation does not occur more often. The copious intake of fluids, 3000 to 4000 c.c. daily, and a well-balanced diet with adequate protein and vitamin A content are general measures to be enforced. Usually the patients have been taking one of the sulfonamides with adequate alkalinization to prevent sulfonamide crystalluria. In such instances it may be desirable to discontinue this regimen and acidify the urine by bladder irrigation with Suby's solution G and the oral administration of ammonium chloride. When pelvic fractures are observed roentgenographically from time to time it should be especially noted whether there are calcareous concretions involving the urinary tract.

Impotence not infrequently follows rupture of the urethra.[25,26] Usually impotence is permanent. Dilatation of the urethra with the application of silver nitrate solution to the posterior urethra and reassurance of the patient may assist in restoring this function.

A peri-urethral abscess may result from extravasation following ruptured urethra. This complication may be easily overlooked because of swelling and ecchymosis in the perineum. If unexplained fever is present and palpation reveals a fluctuant tender perineal mass, incision and drainage are indicated.

Decubitus ulcer is a common complication of fractured pelvis and especially so when there is a urologic injury with leakage of urine. Harrison[17] stresses its grave importance if it is not antici-

pated. Prophylaxis is the treatment par excellence for decubitus ulcer. It is the duty of the orthopedic surgeon to maintain the fracture apparatus in such a way as to protect susceptible areas of involvement. Likewise, the duty of the urologist is to insure good catheter drainage and maintain a dry bed. Careful, vigilant nursing is imperative.

Summary and Conclusions

1. One hundred twenty-six fractures of the pelvis with 30 urologic complications are reviewed.

2. In this series urologic complications occurred most commonly in young negro males as a result of multiple pelvic fractures sustained in vehicular accidents.

3. Urologic injuries consisted of 11 ruptured urethras, 5 ruptured bladders, 2 contusions of the bladder, 2 hematomas of the bladder, 2 contusions of the kidney and there were 8 instances of hematuria of undetermined origin.

4. In the group of 30 patients with fractured pelves with urologic complications, there were 11 deaths (37 per cent). Of the 96 pelvic fractures without urologic complications, there were 6 deaths (6 per cent).

5. Methods of diagnosis, late complications and treatment of urologic complications are reviewed. Urologic diagnostic measures, complications, and their management are discussed.

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GASTROSCOPY IN RELATION TO GASTRIC SURGERY

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FROM the surgical standpoint, in the opinion of the author, the gastroscope is a great aid in the diagnosis and treatment of patients with digestive symptoms. It will not only reveal the presence of an unsuspected gastric lesion but it will often clarify a hazy diagnosis.

With the advent of the flexible gastroscope the innermost secrets of the hidden recesses in the gastric cavity were revealed to the examining eye while still in their normal surroundings. Previous to this time very little was learned of these secrets by the use of the rigid type of gastroscope, for only a small part of the gastric mucosa could be visualized and important lesions were easily overlooked. Now that the greater part of the lining of the stomach has been under the careful scrutiny of direct vision for more than a decade much has been learned of the normal appearance of the mucosa and of the pathologic changes that affect it.

The correct interpretation of the nature of the findings is not always easy, for it has been found that the appearance of the normal mucosa varies from time to time, even in the same individual, and gastroscopic experts will differ in their opinions. However, as time passes and the facts gleaned by more and more observers are accumulated and recorded, correct diagnoses will be more readily made in a greater percentage of cases.

The gastroscope is not an instrument to be used to the exclusion of other recognized procedures in the complete study of a patient with gastric complaints but should be used as an addendum to the diagnostic armamentarium. At times, patients have symptoms of severe gastric disease with normal x-ray findings. This does not signify that the roentgenologist has improperly interpreted his findings but that, because of any one of several factors, the barium has failed to outline the diseased area. In fact, the author's interest in gastroscopy began when 3 successive patients with gastric hemorrhage were studied and the cause of the bleeding could not be ascertained.

The passage of the gastroscope is not a difficult procedure and can be carried out in the office. There are a few contraindications, but unless they are ignored no accidents should occur. As in all other operations the more experienced the operator the more suc-

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cessful the examination will be. Nine of the author's patients were uncooperative and either no examination, or an incomplete examination, was made. These patients were all highly nervous when brought to the gastroscopic room. Three of these patients were subsequently re-examined and a satisfactory study was completed. There were 4 patients who fainted and no attempt was made to pass the scope on them. It was thought that in 3 of these cases syncope was due to debility and in the fourth to sensitiveness to pontocaine. All 4 soon regained consciousness and no ill effects resulted. One was gastroscoped at a later date without incident.

One of the chief values of the gastroscope in surgery is its aid in making an accurate diagnosis of gastric pathology. It is not unusual to study a patient who has a typical history of a chronic gastric ulcer and yet the x-ray fails to reveal the ulcer. In some cases this is due to a plug of mucus filling the crater and preventing the barium from entering. Other cases are due to a blood clot preventing the opaque medium from filling the ulcer niche, and other ulcers are so shallow that the barium will not remain in the cavity of the ulcer, thereby preventing a correct diagnosis. These are the types of cases where the gastroscope makes it possible to arrive at a correct conclusion. This was beautifully exemplified in a 40 year old white female who had had 3 hemorrhages of moderate severity and yet no filling defect could be seen in the stomach on the x-ray film. Under gastroscopic observation, a benign ulcer, the crater of which was filled with a blood clot, was located on the lesser curvature in the distal third of the stomach. Had the gastroscope not been available for the study of this patient a diagnosis of gastric hemorrhage of undetermined origin would necessarily have had to be made. This patient was operated upon, partial gastric resection performed, and a complete recovery made.

At times the gastroscope is of great value in distinguishing between a benign and a malignant ulceration of the stomach. This is of especial importance where the lesion is malignant. It is true that a large percentage of these cases will be correctly diagnosed by the roentgenologist but there is a small number, especially the small lesions, where the malignant ulcer can not be distinguished grossly from the benign ulcer, except by direct vision of the lesion in situ. The gastroscopic appearance of each type is distinctive and affords a diagnosis of malignancy in the early stages of the disease when a radical operation can bring about a cure. Furthermore, gastroscopy is accurate in determining whether a cancer has passed the stage of resectability. This recalls to mind a patient with symptoms referable to the stomach who was x-rayed with negative results. Six

months later the patient had another gastrointestinal study and the x-ray revealed an extensive carcinoma of the stomach. A gastroscopic study at this time also showed the presence of an extensive carcinoma that had passed the stage of operability. An exploratory operation was performed and metastases were found in the neighboring structures. There is no doubt that had this patient been gastroscoped at the time of the first x-ray study the malignant lesion would have been found and possibly the pathology might have been completely removed before extension to other structures had taken place.

Whenever a patient with a gastric ulcer is undergoing a nonsurgical form of therapy for the cure of the ulcer it is wise to follow the progress not only with the x-ray, but also by frequent gastroscopic examinations. There is the occasional case where the x-ray erroneously shows the ulcer to be completely healed. The patient goes joyously on his way, laboring under a false sense of security, later to have the symptoms recur or, what is worse, to have the ulcer prove to be a malignancy. The importance of gastroscopy in this type of case is recognized more and more. It is another means at hand to determine more precisely the effectiveness of the treatment and further to remove guesswork as to the improvement being made. It can be determined whether the size of the ulcer has changed either for better or for worse. Even the very shallow ulcers can be seen and when complete healing has taken place the remaining scar will be visible. Any regression that may occur will be readily detected and the necessity for surgical intervention can be made known. By early combined use of the x-ray and gastroscope, fewer patients with malignancy will pass the stage of curability.

Even duodenal ulcers occasionally give gastroscopic evidence of their presence. Of course, the ulceration itself cannot be seen but in those cases with some degree of obstruction and marked pylorospasm there is often found thickening of the mucosal folds with gastritic changes in the distal part of the stomach. In patients with a typical ulcer history, although the x-ray fails to show the ulcer, its presence should be highly suspected when such changes are observed. I have noted these changes several times and each diagnosis was proved correct either by further x-ray study or by exploratory operation. Not all patients with duodenal ulcer, however, present this picture and many of them show normal gastroscopic findings.

The most interesting patient the author has had the privilege of studying gastroscopically was one who had a foreign body in his stomach. It was interesting, first, because of the infrequency of the

condition and it is still rarer to view it through the gastroscope. Schindler, in his book "Gastroscopy," published in 1937, stated that Moersch and Walters seemed to be the only ones that had gastroscoped such a case. Secondly, it was interesting for the true nature of the disturbance was not disclosed until the stomach had been opened in the operating room. The history was not typical of any specific entity and was only of one week's duration. The x-ray showed a filling defect in the middle third of the stomach on the greater curvature which was thought to be a papilloma. On gastroscopy in this same area the mucosa was seen to be very red and edematous, simulating the broad bases of two papillomata. In the center of these areas were brilliant shiny green and brownish areas that gave the appearance of necrotic tissue. The gastritic changes passed on toward the cardiac portion of the stomach. The gastroscopic diagnosis was papillomata that had undergone malignant changes and passed the stage of curability. At operation all concerned were greatly surprised and pleased to learn that neither papillomata nor malignancy were present but that the symptoms were due to the presence of five phytobezoars that had become embedded in the gastric mucosa. The foreign bodies were removed, the incisions in the stomach and abdominal wall were closed without drainage and an uneventful recovery ensued. At times, it matters not how many diagnostic procedures are used, all may fail in arriving at a correct conclusion of the problem under consideration.

Following a stomach operation regardless of whether it was a gastroenterostomy, a partial resection or some other procedure, some patients continue to have symptoms and others develop them after a period of comfort. Until the gastroscope came into use in studying these postoperative stomachs, the cause of the complaints was not known in many patients, for all methods of study gave negative findings. It was learned by gastroscopy that few of the patients had ulcers, either gastric or gastrojejunal, but they did have gastritis of varying degrees of severity and there was imperfect functioning at the site of the anastomosis. Those patients who had become symptom-free following operation had no gastritis and the anastomotic area functioned more or less as a normal pylorus. One of the great things that has been learned from the gastroscope is that there is such an entity as chronic gastritis.

This discussion has tried to point out the advantages to the surgeon derived from the use of the gastroscope. In the vast majority of cases a proper diagnosis can be arrived at by other means but there is the occasional case where the diagnosis can not be made without it. There are certain blind spots where a lesion cannot be

seen by the gastroscope and there are certain areas where the x-ray will fail to show an existing lesion. However, the areas blind to one of the methods will be seen by the other. Therefore, patients whose study combines both methods are less likely to have lesions overlooked. The gastroscope will probably never supplant the x-ray, but as time passes and its advantages are appreciated, it will be used more frequently.

The gastroscope is not infallible. Mistakes can be made, for gastroscopy is a difficult study. There are many variations in the appearance of the normal gastric mucosa and lesions may be overlooked. A small ulcer, for instance, may be hidden from view by folds of the mucosa. Usually it is easy to differentiate the benign from the malignant ulcer, but at times this distinction is hard to make. With the gastroscope the lesion is seen in its normal surroundings with the circulation intact and it has an entirely different appearance from that at the operating table where the circulation has been altered or in the pathologic laboratory where there is no circulation. Since this method of study is comparatively new the significance of these pictures have had to be learned. The same was true of the x-ray thirty years ago. As time passes, knowledge of these minor mucosal changes will be more clearly understood and few errors will be made in their interpretation.

MANAGEMENT OF TUMORS OF THE SUPERIOR MAXILLA AND ADJACENT STRUCTURES

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This paper will make no attempt to survey all the cases of tumors of the superior maxilla and adjacent structures which have been admitted to the service of Otolaryngology and the Department of Oncology of the John Gaston Hospital or those seen by the staff of this institution. It will rather present the pertinent facts in a concise discussion of the tumors of this region and cite representative cases of particular interest.

Classification of Tumors

A. Benign

1. *Nasal Polyps*

The most common cause of nasal obstruction is simple polyps. Occurring as a result of hyperplasia and chronic inflammation of the mucous membrane of the nose and accessory nasal sinuses, these masses vary in size and are soft, pallid, pedunculated, pseudo-tumors usually attached to the lateral wall of the nose about the ostia of the sinuses or continuous with the mucous membrane from within the sinuses. Occasionally a choanal polyp is seen which varies from the common variety only in its location. The point of attachment of the latter can usually be traced to the natural ostium of the sphenoid sinus. Hyperplasia with frequent polyp formation of the mucous membrane of the accessory sinuses is present in all such cases. Microscopically, there is edema of the submucosa, which is infiltrated with plasma cells, lymphocytes and usually numerous eosinophils. The mucosa is ciliated columnar epithelium which may show areas of acute inflammation and ulceration. The presence of large numbers of eosinophils in the infiltrate and the frequent history of other allergic manifestations in the individual has led to the general acceptance of the belief that polyposis is a manifestation of allergy. There are nasal polyps associated with malignancies and other conditions in this region which of course have no allergic background.

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2. *Papillomata*

Papillomata are fibro-epithelial tumors that are characteristically benign. Although found frequently elsewhere in the body they are not uncommonly associated with chronic sinus infections, and produce no additional symptoms unless there is spread to the nasal cavity, thereby causing obstruction. Occasionally the growths may entirely fill the accessory sinuses of the nose and there may be absorption and destruction of the surrounding body structure. The bulk of the growth is formed by the ciliated stratified columnar epithelium which is continuous at its base with the surrounding epithelium. The core of the papilloma consists of supporting connective tissue and varies as to its length, thickness and tendency to branch. This connective tissue forming the core is continuous with the connective tissue of the surrounding submucosa and may be rather highly vascularized. Microscopically the papillary arrangement is obvious because of the numerous islands of connective tissue surrounded by stratified ciliated columnar epithelium. Although mitotic figures are frequently found, there is no infiltration of the epithelium about the base. Should the latter be present it is strong evidence of malignant transformation. Repeated recurrences after removal should be followed carefully for it is this type which often develops malignant characteristics.

3. *Fibromata*

These tumors are benign, of connective tissue origin, and usually classified as of two types: (1) soft and (2) hard, depending upon the predominance of the cells or of the fibrous tissue. Although a fibroma may develop in any location where there is fibrous tissue, the type which is of particular interest in this discussion is that known as juvenile nasopharyngeal fibroma. It is not a common tumor, but, when seen, presents quite a problem in management. It is found predominantly in young males, usually between the ages of 10 and 25 years. Grossly the tumor is extremely firm, being attached to the vault of the pharynx by a broad base, and because of this broad attachment growth extends in several directions. The point of origin is from the basilar fibrocartilage, upper cervical vertebrae, or the internal lamina of the pterygoid process, and as it grows forward it may completely occlude both nasal cavities and involve the accessory sinuses. Microscopically the fibrous tissue is very dense and the cellular structure very scanty. Unlike most fibromas the tumor is very vascular, and the vessels may be so large as to appear cavernous. It is this latter feature which accounts for the difficulty encountered in surgical removal of these tumors.

4. *Osteomata*

Osteomata are benign neoplasms composed of bone which grows slowly and has a tendency to displace adjacent structures. It is only through this displacement and erosion of surrounding tissue that it manifests malignant tendencies. The tumors vary from those the size of a pea to that of a large hen egg, are irregular in shape, and are found not infrequently in the nasal cavity or accessory sinuses. Three varieties of the tumor have been described: (1) eburnated, or compact and hard; (2) mixed, the periphery compact and the central portion spongy; and (3) spongy, consisting of spongy or cancellous bone. The attachment of the tumor is frequently by means of a broad osseous base, but it is not uncommon to find the only attachment to be a connective tissue pedicle containing the nutrient vessels. Occasionally the osteoma is found to lie free in the sinus or nasal cavity, and close examination of the tumor will usually reveal a small roughened area through which it apparently receives its nourishment. It must be borne in mind that osteomata of the sinuses may encroach upon the cribriform plate, and meticulous care must be exercised in their removal. Microscopically the tumors are usually covered with ciliated columnar epithelium. The submucosa is interspersed with capillaries, round cells and mucous glands. The periosteal covering is usually of two layers; a thin outer and a fairly thick inner germinative layer which extends into the mass of the tumor. The spongy portions of the osteoma should be considered its younger and the compact portions its older parts.

5. *Giant cell tumors*

A benign, slowly growing bone tumor occurring in almost any bone of the body, but most commonly affecting the epiphyses of the long bones. Growth of the giant cell tumor is progressive and results in excavation of the cancellous tissue and formation of a multicystic tumor. The periosteum of the bone remains intact and lays down new bone. Hemorrhage within the cyst is common and the cavity usually contains a bloody or straw-colored fluid. Microscopically there are numerous fine capillaries, many with endothelial buds, spindle stroma cells, and the characteristic giant cells which may make up the bulk of the tumor. There is a definite capsule with areas of active bone formation.

6. *Tumors of Dental Origin*

Tumors of dental origin involving the superior maxilla arise from peridontal epithelial rests and are classified in four groups: (1) radicular cysts, (2) dentigerous cysts, (3) adamantinomata and (4) odontomata. The radicular cyst is a slowly growing, benign

tumor derived from the root of a devitalized tooth. A higher percentage of molar teeth are affected than incisors, and the majority are found in young adults. The tumor is a monolocular cyst, containing no teeth and possessing an extremely thin wall. As a result of the development and growth of the tumor, pressure necrosis of the surrounding bone occurs.

The dentigerous cyst is also a slowly growing, benign tumor but arises from the enamel organ of an unerupted tooth. The cysts are usually monolocular but can be differentiated from radicular cysts by the presence of one or more imperfectly developed teeth.

The adamantinoma (ameloblastoma) is a slowly growing, low grade malignant tumor arising from the enamel organ of an unerupted tooth. More commonly seen in the lower jaw it does invade the superior maxilla and may be either a solid or cystic tumor. Although metastases are rare and occur late in the growth of the tumor, marked destruction of the surrounding tissues occurs from the expansion of the tumor.

Odontomata are firm, slowly growing, benign tumors composed of masses of abortive teeth and are mentioned merely to complete the classification because these tumors almost invariably involve the lower jaw.

B. Malignant

1. *Carcinomata*

The majority of malignant tumors (epithelial) occurring in the region of the upper jaw are of the squamous cell variety; however epithelioid or transitional cell carcinomata are found quite frequently as might be expected in an area of variable epithelium. Also as might be expected in this type of epithelium adenocarcinomata not infrequently are found. Practically all these tumors arise from the mucous membrane of the nasal cavity or accessory sinuses, the most common location being the middle turbinate at the embryonic sites of origin of the sinuses. Because of the magnitude of these tumors when discovered, in many cases it is impossible accurately to determine their site of origin. The nasopharynx quite commonly gives rise to malignancies about which there is considerable controversy as to their true character. These are the lymphoepitheliomata (Schmincke) which have constituted an appreciable percentage of the cases seen in this institution although they are not primarily upper jaw tumors.

The degree of malignancy of all four types of carcinomata mentioned varies greatly; however, it may be said that many of them are of relatively low grade malignancy and metastasize slowly even

though their extent of local involvement may be considerable. Distant metastases of adenocarcinomata may occur before involvement of the regional lymph nodes takes place; however, this is practically never true of the squamous or transitional cell tumors or of the lymphoepitheliomata. It is this fact combined with the difficulties involved in giving adequate x-ray therapy to this area which makes surgical removal with follow up x-ray therapy the procedure of choice in this institution. The frequent occurrence of squamous cell carcinomata in mucous membrane which is normally composed of columnar epithelium is attributed by many authors to a regression of the normal epithelium to a squamous cell type as a result of chronic infection. Others attribute this fact to the presence of islands of misplaced embryonic epithelium in the normal mucosa. The site of origin of many of these tumors would tend to support the latter theory.

The cellular structure of the squamous cell variety of tumors in this area is identical with tumors of this type in other parts of the body. Hornification of the outer layers is seen in about half the cases. The cells are rather well differentiated in the majority of these cases, and the stroma is as a rule fairly vascular. Adenocarcinomata in this region are not unlike those in other parts of the body in their cellular characteristics and are the most highly malignant of all the epithelial tumors of the upper jaw. The transitional cell carcinomata are well differentiated and show characteristic low cuboidal or transitional cell structure which is infrequently seen in other parts of the body. They are rapidly spreading but slowly metastasizing types of tumors. The lymphoepitheliomata of Schmincke are so designated because of the presence of large amounts of lymphoid tissue interspersed among the epithelial cells. However, a large number of pathologists consider this tumor as being merely a low grade squamous cell carcinoma arising in lymphoid tissue and place no significance in the presence of the latter type of tissue other than that it acts as a "bed" for the former.

A fifth type of carcinoma which not infrequently invades the upper jaw is the basal cell tumor which arises from the skin of the face, most frequently the upper part. This tumor is of low grade malignancy and metastasizes very late, or not at all; however, it is locally quite destructive and when neighboring bony structures are invaded the difficulties of treatment become great. The cells of this tumor resemble those of the basal layer of the epithelium and are thought by many to arise from this layer, whence they extend quite uniformly in strands into the underlying stroma. On their

surface they become rather characteristically ulcerated and this degeneration continues as the lesion progresses.

2. *Sarcomata*

These are rapidly growing, locally destructive, malignant tumors of connective tissue origin occurring most frequently in the middle and advanced age groups. They may be one of two general types, (1) immature or undifferentiated, and (2) differentiated forms. Grossly a sarcoma is usually soft, bulky, and very vascular. The various differentiated forms (fibrosarcoma, chondrosarcoma, osteosarcoma, liposarcoma, myxosarcoma, angiosarcoma, myosarcoma and lymphosarcoma) may vary in appearance dependent upon the predominant tissue present in the tumor and its vascularity. Metastases as a rule occur through the blood stream and with one exception, lymphosarcoma, the presence of metastases in lymph nodes is most unusual. Microscopically, three different groups are recognized, depending upon the cell form: (1) spindle cell, (2) round cell, and (3) giant cell. The cells are usually large and numerous and are arranged in bundles which ramify irregularly through the tumor. Areas of necrosis, infarction, and infection are prominent.

Symptomatology and Diagnosis

As in all branches of medicine the tumors encountered in this region may be either benign or malignant. Some of the more common symptoms presenting in either type of tumor are, roughly, in order of frequency:

1. Nasal obstruction
2. Nasal discharge
3. External deformity
4. Intra-oral deformity
5. Pain
6. Ocular disturbances

To illustrate the above listed symptoms the following case reports are presented:

1. *Nasal obstruction*

This symptom is seen at some stage in practically all cases of tumors of the region under discussion. The following case histories are particularly illustrative:

Case 1. A benign Angiofibroma of the Nasopharynx (Juvenile Nasopharyngeal Fibroma) in a 14 year old boy (C.K.) who complained of nasal obstruction for a period of one year, becoming progressively worse and block-

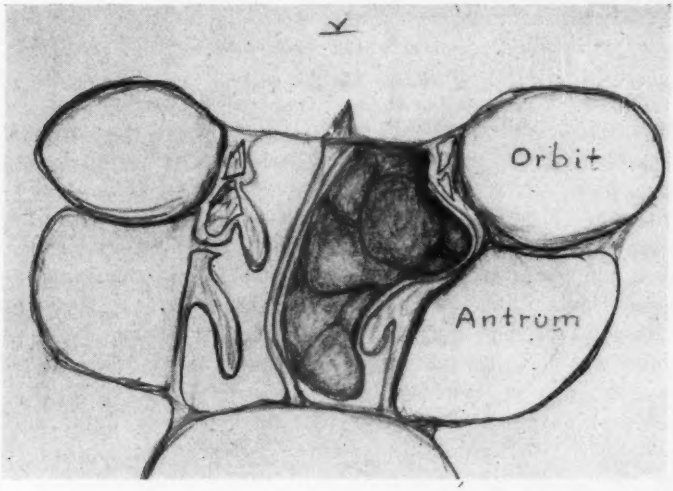

Fig. 1. Case 1. Juvenile Nasopharyngeal Fibroma, filling the entire left side of the nose and displacing the septum to the right.

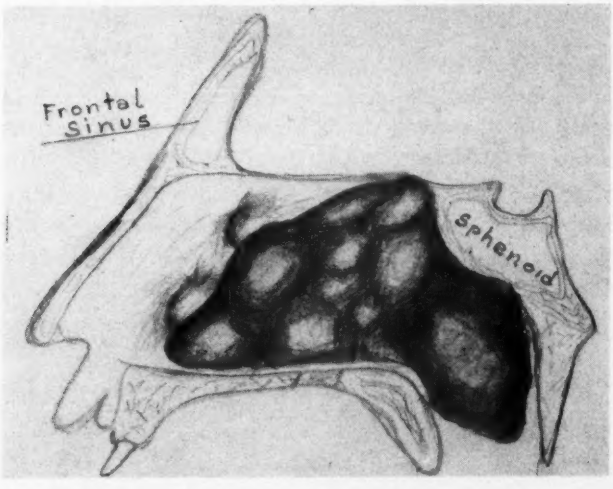

Fig. 2. Case 1. Nasopharyngeal Fibroma, filling the posterior two thirds of the nasal cavity and nasopharynx. Attachment of tumor to posterior, superior, and lateral walls of the nasopharynx.

ing the left side of the nose completely. Examination revealed a firm tumor completely filling and obstructing the left side of the nose and forcing the septum far to the right. It was impossible to determine the exact site of attachment of the tumor. Because of the profuse bleeding which accompanied any manipulation, ether anesthesia was used, a postnasal plug inserted, and

an external approach made through the ethmofrontal region. There was a large opening in the paper plate and both the ethmoids and the frontal sinus were filled with polypoid mucous membrane which was exenterated. The tumor was exposed in the nose and a large portion removed with scissors, knife, and punch forceps. Hemorrhage was so severe, however, that the operation was discontinued. Pathologic studies revealed the tumor to be a benign angiofibroma, and the second stage of the operation was done three weeks later. The same approach was used and the tumor was found to be firmly attached to the posterior, superior, and lateral walls of the nasopharynx. The mass was removed by fulguration and sharp dissection, the growth bleeding profusely during the first part of the operation but very little during the latter half and none after the tumor was completely removed. The septum was pressed toward the left, giving ample aeration to the right side of the nose.

CASE 2. A Fibrosarcoma of the Antrum, occurring in a colored male (Palmer P.), aged 72 years, first seen on Oct. 19, 1943, with chief complaint of "right side of nose blocked." Patient stated that 5 months previously he had noticed that his right eye was inflamed and apparently swollen. Shortly after this he had begun to experience some difficulty in breathing through the right nasal cavity, and his attempts to clear the nose by blowing had resulted in nosebleeds. The swelling of the eye and the nasal obstruction became progressively more marked until he eventually sought medical attention. There had been no pain associated with the disease, and the patient had noticed no change in his ability to see. There had been a weight loss of 15 pounds during the last 2 months of the disease.

Examination revealed marked exophthalmos, right; the scleral vessels were injected and there was increased lacrimation. Studies of the fundus showed no abnormalities. The right cheek appeared full, and the right nasal cavity was completely filled and obstructed by a firm mass which extended from the lateral wall of the nose. There was no gross involvement of the alveolar ridge, hard or soft palate.

On November 2, the right external carotid artery was ligated; the right orbital contents exenterated and the superior maxilla removed. A soft, friable tumor about the size of an egg was found in the region of the ethmoids which extended into and filled the frontal, sphenoid, and antrum on the right side. The dura of the anterior cranial fossa had been exposed over an area of 3 cm. in diameter due to expansion of the tumor, but there was no gross evidence of intracranial extension of the growth. Microscopic examination revealed a fibrosarcoma of the spindle cell variety.

2. *Discharge*

With the exception of polyposis associated with sinusitis, nasal discharge is not a prominent symptom of benign tumors. Bloody mucus or mucopus in the nose, although occurring quite commonly with nasal granulomas and angiomas, should always lead one to suspect a malignancy. An excellent example is furnished by Case 3.

CASE 3. A Transitional Cell Carcinoma of the right antrum occurring in a white female (Mrs. Mattie N.), 64 years of age, first seen in the Outpatient Department on Feb. 23, 1945, complaining of several recent attacks of epistaxis from the right side of the nose. Examination revealed several small

superficial vessels in Kisselbachs septal triangle which were crusted over. Medical examination was essentially negative. The blood pressure was 160/100. The septal vessels were cauterized and ephedrine nose drops prescribed. The patient was seen several times in the next six months and stated each time that she had a bloody nasal discharge occasionally but only rarely a frank nosebleed. Examination each time revealed a few crusts in the right nasal cavity which were removed without difficulty and without precipitating epistaxis. No masses or ulcerations were noted. She stated that the use of nose drops usually stopped the bloody discharge for several days.

Fig. 3. Case 3. Operative field after removal of upper jaw and exenteration of right orbit.

After an absence of several months she was again seen in the clinic in November, 1945, complaining of recurrence of the bloody discharge and of dull aching pain in the right supra-orbital region with radiation to the right temporal area. The right lateral nasal wall appeared much redder than normal and gave an impression of slight bulging. X-rays taken at that time showed considerable increased density of the right ethmoids and antrum and also of the left antrum. Efforts to irrigate the right antrum were unsuccessful and hospitalization was advised but refused.

The patient did not return until February, 1946, when marked purulent, bloody discharge, right nasal obstruction, and pain prompted her to seek further medical attention. The right nasal cavity was partially filled with a friable, bleeding, granular mass which appeared to arise from the middle meatus. There was much pus in this side of the nose and marked tenderness was present over the right antrum, ethmoids, and frontal sinus, with a suggestion of fullness of the right cheek. The edentulous right upper alveolar process was edematous, bluish in color, and extremely tender. X-rays were repeated and revealed complete opacity of the right antrum with infiltration and destruction of the inferior, medial, and superior walls of the sinus.

On February 6, biopsy of the intranasal mass was made and reported as "transitional cell carcinoma" or "undifferentiated carcinoma." X-ray therapy was begun immediately, and 2400 Roentgen units given when severe skin reaction necessitated withdrawal.

She was admitted to the hospital and on April 16, 1946, the right maxilla was resected and the ethmoids on that side exenterated. The floor of the orbit was removed but the orbital contents, which did not appear to be involved, were left intact. Postoperative course was uneventful, and the patient was discharged to the Outpatient Department for further observation on May 11. Thereafter careful inspection of the cavity was made frequently through the operative defect in the hard palate. The surgical specimen was reported as squamous cell carcinoma at this time.

In August, 1946, a suspicious-looking granulating mass appeared within the cavity in the ethmofrontal angle, and the patient was readmitted to the hospital for implantation of radium in this area, following which a second course of 2000 Roentgen units (x-ray) was given. The mass completely disappeared and the patient was asymptomatic following this procedure until January, 1947. A very satisfactory prosthetic dental appliance was worn during this time. In January, however, she began to have considerable pain in the right orbit which persisted and on February 22, reopening of the upper part of the old wound revealed a marble sized, firm, friable mass in the soft tissue of the orbit beneath the globe. This was removed and reported as adenocarcinoma. The orbit was completely exenterated at that time, and all soft tissue deep to the skin of the cheek was resected through the orbital wound. Recovery was rapid and to date there has been no evidence of further recurrence, the patient being asymptomatic.

3. *External Deformity*

While external deformity occurs late or not at all in most benign tumors of this region, it is an early and prominent sign of dental cysts and malignancies of the upper jaw. The following cases are illustrative:

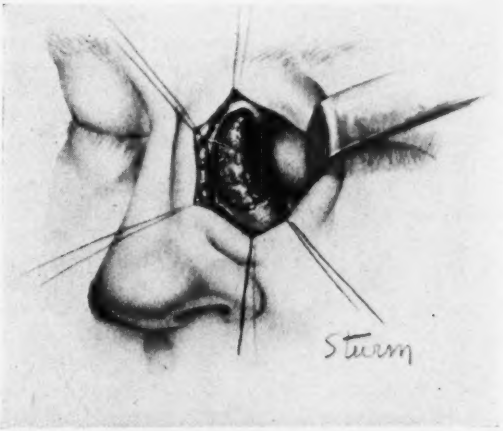

Fig. 4. Case 4. Giant Cell Tumor of the left ethmo-antral region. Operative approach through the ethmo-frontal area.

CASE 4. A Giant Cell Tumor occurring in a 7 year old child (B. F.), a

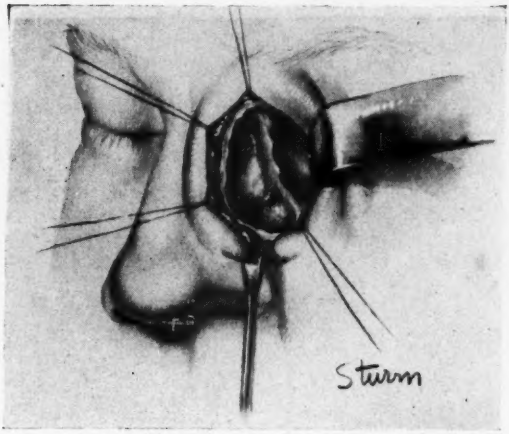

Fig. 5. Case 4. Giant Cell Tumor of the left ethmo-antral region. Operative field after the tumor has been removed.

white male first seen Jan. 2, 1940, with a history of a "growth" in the left ethmo-antral area of one year's standing, gradually increasing in size. There had been moderate discharge from both sides of the nose with obstructed breathing. Findings at examination were a hard, raised mass in the left ethmo-antral area, protruding about one fourth inch above the surrounding surface, and a mass partially filling the left nostril. The following day, through an external ethmofrontal approach, the periosteum was easily detached from the underlying, protruding mass which had a complete bony covering. This mass, including the bony covering, was outlined and exposed with a sharp elevator and removed practically intact through the external wound. The growth seemed to be displacing the normal bone. Microscopic studies revealed the tumor to be a giant cell type. Recovery was uneventful and there has been no recurrence.

CASE 5. A case of Fibrosarcoma of the Ethmoids in a 63 year old colored male (C.B.) first seen on Jan. 17, 1943, complaining of a severe aching pain in the left frontal region, increased lacrimation of the left eye, and presenting obvious deformity of the nasal bridge, the left eye being forced laterally and protruding somewhat. He stated that he had had some polyps removed from the left nostril in 1933 but that for the past 2 years had been unable to aerate that side of his nose, had had frequent attacks of left side epistaxis for the past several months, and had noticed increasing deformity of the left eye for several months.

On examination the marked facial deformity was seen to be produced by a bulging mass situated between the eyes and extending upward onto the forehead. The left eye was forced laterally and downwards by the mass which was firm, immobile, non-tender, and not attached to the skin at any point but fixed to the deep structures. The bridge of the nose was widened and prominent, and the nasal bones could be palpated. Anterior rhinoscopy revealed a mass that completely occluded the left nasal cavity, forcing the septum to the

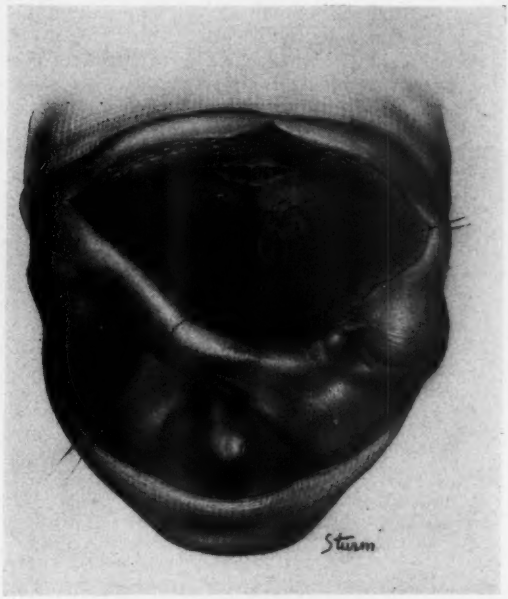

Fig. 6. Case 5. Drawing of operative field showing marked destruction of bone, dural exposure, and area of attachment of tumor to the lumen.

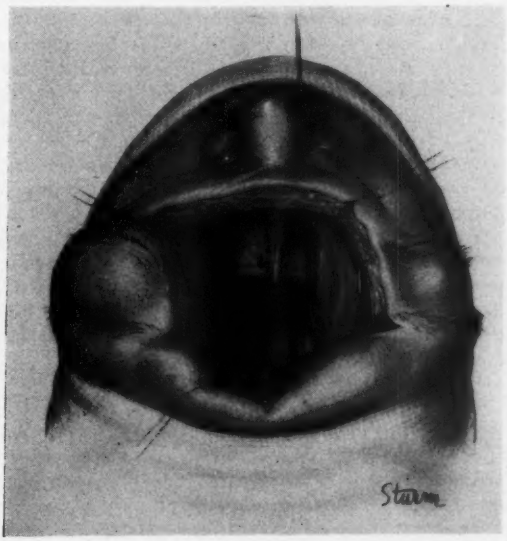

Fig. 7. Case 5. Operative field as viewed from the head of the table showing destroyed septum of the nose and probe in right Eustachian tube.

right. This mass was firm, red, smooth, slightly tender, and movable with an applicator. X-rays revealed a destructive process involving the maxilla, malar, and frontal bones on the left with probable involvement of the ethmoids and sphenoid on that side. Lateral x-ray of the neck was negative. No cervical glands were palpable.

Fig. 8. Case 5. Patient (C.B.), 4 years after operation.

On January 19, biopsy of the intranasal mass was taken and reported as probable fibrosarcoma of low grade malignancy. Because of the magnitude of the mass deep therapy was considered the treatment of choice. However, before this could be instituted the patient developed signs of sepsis and the mass became swollen, painful, and fluctuant so that incision and drainage were deemed advisable. This was carried out and thick yellow pus evacuated after which the anterior surface of a tumor mass could be seen beneath the skin. This mass appeared smooth, glistening, was apparently encapsulated, and appeared to lie in the left ethmoid region. Hence an attempt at enucleation was considered. On January 30, the mass was removed in toto and was found to be attached on its posterior superior aspect by a pedicle which arose from the region of the posterior ethmoids. The ethmoids, antrum, and frontal sinuses were completely exenterated at a later operation. Within a short time after removal of the tumor the entire area was covered with healthy granulations, and the cavity reduced in size by about half through movement of the orbital contents back into almost normal position. This patient was alive and showed no evidence of recurrence when last seen in the fall of 1946.

4. *Intra-oral Deformities*

Inspection of the upper alveolar process and palate will frequently reveal evidence of invasion from tumors of the superior maxilla as illustrated by Case 6.

Case 6. A Radicular Cyst. Mr. R.E.T. was first seen June 7, 1944, at the John Gaston Hospital exhibiting a discharging sinus in the region of the upper left lateral incisor tooth which had been extracted 10 years previously. History revealed that the onset of discharge had been 10 days prior to admission; however, the same area had abscessed and drained for 2 days about one

year previously following which there had been increasing swelling of the left cheek, swelling of the left side of the hard palate, and left nasal obstruction.

Physical examination revealed increased prominence of the left cheek and fullness of the canine fossa which was seen within the mouth. The left side of the nose was almost completely closed, being more marked near the floor of the nose. There was protrusion of the hard palate downward on the left

Fig. 9. Case 6. X-ray of Radicular Cyst filled with opaque medium.

side with an area of softening about one and a half inches in diameter in its center portion. The draining sinus as described above was noted. X-rays showed an indefinitely outlined mass in the region of the left antrum and floor of the nose.

Under local anesthesia a Caldwell-Luc type of incision was made, and the anterior maxillary wall seen to be very thin. A small opening was made in the wall and one ounce of straw-colored fluid containing several shiny particles was aspirated through a large needle. The cavity was filled with iodochloral and x-rays made after which the thin anterior bony wall was removed. A large cavity was seen to occupy the left antral region and extend under the floor of the nose to the opposite side. The membrane lining the cavity was exenterated without difficulty and was stripped of the mucous membrane of the hard palate with which it was in contact through a bony opening (dehiscence) about one inch in diameter. There was no suggestion of malignancy. The cyst appeared to have originated from the left upper canine tooth region. A large opening was made into the inferior meatus and floor of the nose by removal of the mucous membrane in this region. The patient made an uneventful recovery.

5. Pain

This is as a rule not a prominent symptom unless the tumor is so extensive as to produce sinus blockage, invade the trigeminal nerve

branches, or actually encroach on the cranial contents. Pressure upon the main branches of the trigeminal nerve may produce areas of anesthesia or hyperesthesia long before pain appears.

Fig. 10. Case 7. Patient after removal of upper jaw, malar bone, and anterior wall of frontal sinus and exenteration of the orbit.

CASE 7. A Squamous Cell Carcinoma of the Right Antrum occurring in a colored male (Sherman W.), age 67 years, who was admitted on Dec. 12, 1946. He complained of pain in the right cheek which had been present for 9 months and swelling of the right cheek for 5 months. Onset of the present illness had been in March, 1946, with radiating pain in the right malar region and increasing unilateral purulent nasal discharge (right). Swelling of the right malar region, first noticed in May, had persisted and increased to involve the lower lid partially closing the right eye. During the month prior to admission there had been some bloody nasal discharge. The patient gave a history of "sinus trouble" for a number of years, and x-rays of the accessory nasal sinuses 8 months prior to admission had showed no tumor masses.

Examination revealed: (1) A granulating mass occluding a large part of the right nasal cavity apparently arising from the right lateral nasal wall. (2) The right cheek prominent due to firm induration of the soft tissue. (3) The right eye partially closed due to soft tissue swelling. Movements were normal but proptosis was present. (4) Redness and induration of the hard palate was noted extending posteriorly to the line of the last molar tooth, anteriorly to the first pre-molar and medially to the midline.

On the fifth hospital day, resection of the right maxilla, including the nasal septum, removal of all soft tissues except the skin anterior to the maxilla, exenteration of the right orbit and exenteration of the right frontal, ethmoid, and sphenoid sinuses was performed. The upper part of the wound was left open. A suspicious area soon developed on the lateral margin of the right orbit and on April 2, 1947, the malar bone, anterior wall of the right frontal sinus, and the soft tissue of the right infratemporal fossa was removed. The inner plate of the frontal sinus had been destroyed over an area of 2 cm. and the tumor mass was attached to the dura. After removal of the tumor the cavity was packed and the wound left open. Microscopic examination revealed squamous cell carcinoma, grade 2 or 3, in all sections studied. The patient's condition is good and he is receiving x-ray therapy at the present time.

6. *Ocular Disturbances*

With involvement of the orbit various ocular disturbances are frequently seen.

CASE 8. An Epithelioma of the Left Antrum and Orbit in a colored female (Rachel A.), 60 years of age, who was first admitted to the Ophthalmology service on Dec. 31, 1942, because of itching of the left lid and a heavy sensa-

Fig. 11. Case 8. Patient 3 years after removal of tumor involving antrum, ethmoids, frontal sinus, and orbit.

tion in the left eye, these symptoms having persisted over a period of 3 years. Examination revealed the left upper and lower lids to be adherent in the lateral thirds with edema and redness of the conjunctiva. The cornea was normal, but a small ulceration of the inner canthus was present. On Jan. 12, 1943, a left canthoplasty was performed and notations made that the ulceration of the inner canthus was healing.

This patient did not return for observation until May 3, 1944, at which time she was admitted to the Department of Oncology. The ulcerative lesion of the inner canthus had spread to involve the bridge of the nose. The provisional diagnosis was epithelioma and x-ray therapy instituted. A total of 6500 Roentgen units was given with only temporary improvement followed by a progressive enlargement of the lesion.

On Jan. 15, 1945, she was transferred to this department, and the lesion then seen to be ulcerative with indurated borders and involving the left inner canthus, medial one half of the left upper and lower lids, and the bridge of the nose. Microscopic studies of sections removed from the lesion showed this to be an Adenoid Cystic Epithelioma (Brookes tumor). On Feb. 3, 1945, a radical exenteration of the left orbital contents and all accessory sinuses on the left was performed, including removal of the left nasal bone. This was later followed by a plastic operation to the denuded area of the nose using a pedicle graft from the left frontal region. On Dec. 12, 1945, a biopsy was taken from a small granulating area over the bridge of the nose, pathologic study of which revealed only chronic granulation tissue. At present the entire area is well healed, no evidence of malignancy remains, and the accessory sinuses are free of infection.

As seen from the foregoing discussion, differential diagnosis of such conditions must depend upon a careful and complete examination of every patient. The similarity between "run-of-the-mill" ear, nose and throat conditions and upper jaw tumors is well illustrated by the case histories presented. Any combination of these symp-

toms (with the possible exception of anatomic deformity) occurs frequently in acute or chronic sinusitis with the result that the latter diagnosis is settled upon all too frequently without thorough investigation for the more serious possibilities. If the cases cited appear to present clear-cut diagnoses it must be remembered that most of them had displayed symptoms for a relatively long period of time before medical attention was sought or before the diagnosis became so evident. A slight but persistent bloody nasal discharge (or postnasal discharge) should make one suspicious of the more serious nasal affections and should initiate further exhaustive studies. Any patient who appears to have chronic sinusitis but who responds poorly to the accepted routine methods of treatment should be given more intensive studies in search of an upper jaw tumor without further delay. Repeated x-ray examinations may reveal early bone changes which were not evident on the first examination. The instillation of an opaque oil into the antra by way of the natural ostia (cannula) or by antral puncture through the inferior meatus has been a valuable diagnostic procedure at this institution. The x-ray films taken during this procedure must be made with the patient in the upright position, which will furnish an excellent picture not only of filling defects due to tumor masses, but also of the thickness of the antral lining and the true caliber of the cavity. This procedure may be of particular value in those cases which present nasal obstruction (due to lateral wall encroachment) as a symptom and have negative x-ray findings on the routine sinus plates. In cases of questionable x-ray findings, surgical exploration and biopsy by the most practical routes are "musts." Unless a generous biopsy specimen is readily available through the intranasal route it is the practice at this institution to explore the antrum, ethmoids and sphenoid, if necessary, through a Caldwell-Luc incision in the canine fossa or through the external ethmofrontal approach. Adequate tissue must be obtained for thorough gross and microscopic study by both the surgeon and the pathologist. It is only through such thorough (some may even say radical) measures that a sufficiently early diagnosis of malignancy may be made in the majority of cases.

Surgical Technic

In nasal polyps if the history, clinical findings, x-ray studies, or operative findings are suggestive of possible malignancy, the antrum must be explored through the canine fossa or by intranasal approach, the former being the more satisfactory. This procedure is suggested since pathologic study of the polyps alone may fail to show the features of an associated malignancy.

In papillomas of the antrum and lateral wall of the nose complete surgical removal is required. Recurrence is common and not infrequently microscopic examination may reveal an invasion by the epithelium into the base which is strong evidence of a malignant transformation. In involvement of the antrum by this type of growth the approach to the tumor should be made through the canine fossa.

Fig. 12. Operative field just before removal of osteoma from the right frontal sinus.

Preoperative radium implantation followed by surgical removal of the fibromas, either through the intranasal approach, intraorally through the soft palate, or externally through the ethmofrontal approach, is the treatment of choice. The latter route is preferable.

Osteoma of the antrum is best attacked through the canine fossa approach if the tumor involves the antrum only. If the tumor involves the ethmoid and frontal sinuses as well, the external ethmofrontal approach should be used.

The tumors of dental origin are usually attacked through the oral route. The cyst wall is well defined and an attempt should be made to deliver the cyst intact. Should this prove impossible one must remove all remnants.

Removal of giant cell tumors must allow sufficient exposure to remove the tumor with its entire cyst wall. The location of the tumor will indicate the approach.

Endotracheal anesthesia has been most satisfactory in those cases requiring resection of the upper jaw. Although a common procedure in the past, ligation of the external carotid artery has not been necessary during recent years. Incision is along the lower border of the orbit to the side of the nose, curving around the ala nasi to divide the lip in the midline, this flap being turned outward. Using a sharp chisel and mallet the maxilla is divided from its opposite; the zygomatic bone, the nasal bone, the nasal process of the frontal bone and the hard palate are separated with a saw or heavy cutting forceps and the partially liberated jaw grasped and removed by sharp dissection. The floor of the orbit may or may not be removed depending upon the invasiveness of the tumor. Excision of the tumor must include sufficient normal tissue peripheral to the growth. If there is extension to the other sinuses, as is often the case, or to the orbit, all questionable tissue is to be removed. Exenteration of the orbit is often necessary in these cases. The lower part of the wound, including the lip, is closed; the cavity is packed with iodoform gauze through the upper, open part of the wound. No attempt is made to close this upper portion at the time of operation. All cases are to be followed by irradiation and checked frequently for any evidence of renewed neoplastic activity.

Prognosis

Prognosis of benign tumor cases is quite favorable; especially is this true in nasal polyps and papillomata. In these two types the associated sinusitis with its complications may make the prognosis less favorable. In juvenile nasopharyngeal fibromas, due to the possibility of fatal hemorrhage, the prognosis should be guarded. The preoperative use of radium has decreased this tendency to bleed and greatly facilitated the removal of this type of fibroma. The prognosis in osteomas is favorable if operated upon previous to their encroachment on vital structures, especially the cribriform plate and cranial vault. Should this occur in the presence of suppurative sinusitis, meningeal complications are manifested and the prognosis is much less favorable. Giant cell tumors usually can be removed in their entirety resulting in a favorable prognosis. The radicular cysts, dentigerous cysts, and odontomas although capable of causing marked external deformities about the face are entirely benign and can be removed surgically with little risk. The adamantinoma is considered as a malignant growth, but presence of metastases is so rare that complete surgical removal gives a favorable prognosis.

When dealing with malignant tumors a favorable prognosis hinges upon the following:

1. Early diagnosis
2. Presence or absence of metastases
3. Degree of malignancy
4. Thoroughness of removal
5. Adequacy of x-ray therapy

Unfortunately the signs and symptoms associated with the early stages of malignancy of the upper jaw and adjacent structures are minimized by the patient and too often overlooked by the physician. Needless to say that early diagnosis enables one to handle these cases more satisfactorily. Direct extension to vital structures and metastases to regional lymph nodes are obvious reasons for a poor prognosis. According to Broder's classification, the more differentiated forms (I and II) grow more slowly and show less tendency to metastasize, while the undifferentiated forms (III and IV) usually grow rapidly, metastasize early, and are more susceptible to x-ray. The prognosis is therefore more favorable in the first two classes if seen early. Irrespective of the type, however, complete removal of the tumor mass is a prerequisite to a good prognosis. It is the policy of this department to administer x-ray therapy to all malignant tumor patients postoperatively, but to expect good results without adequate surgery leads to disappointment.

Summary

1. A simple classification of the tumors of the superior maxilla which have been treated in this institution is presented with brief discussions of the pertinent pathologic features of each type.

2. The symptomatology of upper jaw tumors is discussed and illustrative cases are cited to emphasize the importance of these symptoms and signs. Important differential diagnostic procedures are described, emphasizing the urgency of thorough examination, early biopsy, and surgical exploration in questionable cases.

3. Surgical approaches and technic used in the management of these various tumors are outlined.

4. Prognosis in the different types of cases is discussed, with consideration of the factors which determine same.

A REPORT OF RESULTS IN THE TREATMENT OF CANCER OF THE BREAST

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A STUDY of the results obtained in the treatment of carcinoma of the breast in the Cancer Clinic of the University of Tennessee Medical School is presented. The Clinic was established as the outgrowth of the cancer service begun by Dr. Frank Ward Smythe in 1929. Since then, it has developed into the present organization, with adequate professional and clerical personnel for its function.

In selecting the cases for this report from the files of the Clinic, the following basis was used:

1. Those having been treated between the years 1932 and 1942.

2. Those in which the diagnosis was established by the study of tissue sections; or, in advanced cases where no operation was done, by the unquestionable nature of the gross pathology.

3. Those in which the end result of treatment was definitely known.

By these criteria, 181 of the several hundreds of breast cancer cases were found suitable for consideration in this report. A much larger number could not be included by reason of insufficient data as to the end result of treatment. At least 90 per cent of the cases studied were colored. These people change residence rather frequently, and even take different names for one reason or another and, in a city the size of Memphis, are easily lost. Follow-up letters are seldom answered and attempts at telephone contact are not effective. Reports of progress, therefore, have come in part from social workers and district nurses, but for the most part from patients, who have returned to the clinic as instructed. Reports of death, dates, and final diagnosis have been obtained in some cases from the Bureau of Vital Statistics of this city. Loss of medical and clerical personnel to the Armed Forces during the war years further disrupted the Clinic.

In 1931, a plan for the classification and treatment of breast malignancies was formulated and put in operation. This classification was based on the gross pathology present, as determined by observation and palpation, supplemented by x-ray examination of the chest for evidence of distant metastases. Five case groups were defined. These are:

Group I. Patients having a mass in the breast, with the characteristics of a malignant tumor, but without palpable regional lymph nodes or evidence of metastases to distant organs.

Group II. Cases similar to those in Group I, except that the regional lymph nodes were palpable, but not confluent or fixed.

Group III. Cases with the characteristics of Group II, except that the regional lymph nodes were fixed or confluent.

Group IV. Cases in which the gross pathology in the breast and lymph nodes was so extensive as to make radical operative treatment impossible. No evidence of the extent of the lesion beyond the breast affected, and its drainage area, was present.

Group V. Cases with malignant tumors of the breast with evidence of distant metastases.

Groups I, II, and III were treated with adequate preoperative x-ray therapy, followed in 3 to 4 weeks by radical mastectomy after the technic of Sir Percy Stiles. The cutting current was used in all operations. Operation was followed in 4 weeks by postoperative x-ray. Selected cases in which there was extensive lymph node involvement received interstitial radium in the form of needles of ½ mm. platinum filtration equivalent, containing 2 mg. of the element.

Group IV was treated primarily for palliation. This was accomplished by one or more courses of x-ray therapy, and in selected cases by simple mastectomy designed to free the patient of a bleeding or foul sloughing tumor. Radium implantation was done in a few cases. Sedation was given as needed for pain.

Group V cases with distant metastases were given necessary sedation, and, in certain cases, a course of x-ray therapy for relief of pain, or to help control bleeding or sloughing of the tumor.

An overall picture of the cases studied will be seen in Table 1.

It will be noted that the greater number of cases are of the advanced type, falling in Groups III and IV. This situation may be traced to the social and educational level of the large majority of the patients whose cases are listed. It is unfortunate that cancer of the breast in the early stage will often be manifest as a simple painless "lump," easily ignored by the patient of this class, who normally is reluctant to consult a physician until driven to do so by the onset of pain or rapid growth of the tumor. Similarly, little information as to the duration of the disease could be gained from the case histories. Many patients presented themselves for treatment with large, well developed tumors, stating that the mass had been present for only a few weeks.

TABLE 1

Group	Number of Cases	Average Age	Symptom Duration Before Treatment
I	28	48.0	16.8 months
II	26	49.1	14.2 months
III	53	43.4	17.1 months
IV	50	50.6	20.2 months
V	24	47.9	24.2 months

Each group of cases is tabulated below, showing the treatment given and the results.

In Group I, 28 cases were treated, with 4 postoperative deaths, accounting in part for the low survival rate in this group. Group I is shown in Table 2 below.

TABLE 2

Treatment Given	Number So Treated	Average Survival Time	Patients Living at End of 3 yrs.	5 yrs.	10 yrs.
*Routine	18	5.6 yrs.	13	10	4
**Radium	5	3.9 yrs.	2	1	0
***Simple	2	4.5 yrs.	3	1	0
X-ray only	3	4.2 yrs.	2	1	0

*Preoperative x-ray, radical operation, and postoperative x-ray.

**As in "routine" with interstitial radium needles used at operation.

***Cases where intercurrent condition made radical operation inadvisable.

X-ray only—in patients refusing operation after preoperative x-ray was given.

In Group II, 26 cases were treated, with 3 postoperative deaths. The average survival time for the group was 3.9 years. Table 3 will give treatment and results in this group.

TABLE 3

Treatment Given	Number So Treated	Average Survival Time	Patients Living at End of 3 yrs.	5 yrs.	10 yrs.
Routine	21	4.1 yrs.	11	6	2
Radium	0	0	—	—	—
Simple	2	4.2 yrs.	2	1	0
X-ray only	3	2.3 yrs.	0	0	0

Note: "Treatment type" has the same meaning as shown in Group I.

Group III. In this group there were 53 cases with 2 postoperative deaths. The average survival time for the group was 17.1 months. Table 4 gives treatment and results in this group.

TABLE 4

Treatment Given	Number So Treated	Average Survival Time	Patients Living at End of 3 yrs.	5 yrs.	10 yrs.
Routine	42	2.8 yrs.	15	6	0
Radium	9	2.8 yrs.	2	2	0
X-ray only	2	5 mos.	0	0	0

Note: "Treatment type" has the same meaning as shown in Group I.

Fifty Group IV cases were treated with no postoperative deaths. The average survival time for all cases of this group was 17.3 months. Table 5 gives treatment and results in this group.

TABLE 5

Treatment Given	Number So Treated	Average Survival Time	Patients Living at End of 1 yr.	2 yrs.	3 yrs.	5 yrs.
X-ray only	32	13.8 yrs.	20	5	1	0
*Radium	9	9.9 yrs.	3	1	1	0
**Simple	8	19.0 yrs.	5	2	1	0
***Refused	1	1.0 yrs.	0	0	0	0

*X-ray therapy plus interstitial radium.

**Preoperative x-ray followed by simple mastectomy.

***Refused any treatment.

Group V. In this group, 24 cases were treated or observed. A few of this group were given x-ray therapy for reasons detailed above in the discussion of treatment of this group. Cobra venom therapy was given in a small series of these cases for relief of pain, with poor results. The average survival time for this group was 6.8 months. This group is described in Table 6.

TABLE 6

Treatment Given	Number So Treated	Average Survival Time	Patients Living at End of 6 mos.	1 yr.	2 yrs.
Sedation	14	6.6 yrs.	5	3	0
X-ray	10	12.4 yrs.	8	6	0

It would appear that in this group of patients, x-ray therapy may have prolonged life, as well as increased the comfort of the patient.

It is thought that if every breast case of a malignant nature could have been included in this report, the survival rate in Groups I and II and, to a lesser extent in Group III, would have been much greater, and a better picture of results obtained. As before stated, lack of follow-up data prevented this.

Comment

It is apparent from a review of the statistics presented, and from those of other clinics, that satisfactory treatment of cancer of the breast must be based on complete surgical removal of the entire tumor, a procedure made difficult or impossible if the lesion is extensive. X-ray radiation has added materially to the life span and comfort of the patient. There is no evidence in the figures just cited to show that the use of interstitial radium at operation has been of benefit. The whole problem hinges on the factor of early treatment while successful operation is still possible. Therefore, the need of educating the lay public as to the facts about cancer.

In 1944, the plan of treatment just described was modified in that preoperative x-ray therapy is no longer used in Groups I and II. It is possible, however, that preoperative radiation in Group III cases may in some measure increase the chances of a favorable outcome. In late cases, x-ray helped lessen the pain and local tumor sloughing. Testosterone, and the nitrogen mustard compounds are being given to late cases with little to report thus far.

It is hoped that a future report from this Clinic will be more complete and favorable than this one has been.

ACUTE INTESTINAL OBSTRUCTION

Part I—A Critical Survey of the Past Six Years, 1941 to 1946, Inclusive (448 cases)

Part II—A Summary of Fourteen Years' Experience with the "Newer Concepts" in Pathologic Physiology and Treatment, 1933 to 1946, Inclusive (1,143 cases)

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THE pioneer efforts of Wangensteen[28] and his co-workers, since 1931, have inspired a prolonged interest and endeavor on the part of the medical profession to utilize the basic principles involved in the diagnosis, pathologic physiology and treatment of acute intestinal obstruction. The palm is handed to Wangensteen, not that he was the first surgeon to publish practical modern solutions to the complex problem, but because his and his co-workers' stimulating papers brought before the profession pointed summarization of the good work done in the generation preceding him. Those who built the structural foundation of the newer concepts should be recognized. Hartwell and Houget[11] in 1912 noted the prolongation of life in acute intestinal obstruction by the subcutaneous injection of normal saline. This phenomenon was not understood until MacCallum and his associates[14] in 1920 found a marked fall in blood chlorides in acute intestinal obstruction. In 1918, McCann[15] noted the changes in the carbon dioxide combining power of blood. Tileston and Comfort[27] in 1924 described the concomitant rise in the blood nonprotein nitrogen. There soon followed others who gave impetus to the search for new solutions to old problems in obstructions, particularly Haden and Orr,[10] Gamble and Ross,[9] White and Bridge,[33] J. J. Morton[20] and Rowntree.[24] It was during this early productive period that an article appeared in the Journal of the American Medical Association in 1925 by Ward,[32] who described an apparatus for the application of continuous suction to an indwelling nasal Levine tube in cases of acute intestinal obstruction.

It was upon these contributions and observations that Wangensteen built his concepts and gave to us the finished product. His work has aided in the saving of many lives.

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Since Wangensteen's work the renewed interest in Rowntree's work on fluid balance has been greatly embellished and brought to a practical solution by Collar and Maddock.[5] Blalock's[3] contribution on this subject was also of great value. The value of blood and blood plasma in the shock of various obstructions was pointed out early by Moon and Morgan,[19] and by Holman, Mahoney and Whipple.[12] The use of the protein hydrolysates to replenish the depletion of blood protein and amino acids should be credited to Elman.[7] This was a great step forward, and one of the latest, in substituting much needed actual protein instead of plasma or blood. For the past decade, the Miller-Abbott tube[18] has been used in many clinics and hospitals as another adjunct in the rapid deflation of the small intestine. Fine's[8] contribution of 95 per cent oxygen inhalation in distention has found many advocates.

Now, for the past 3 or 4 years the antibiotics, in the form of penicillin and streptomycin, have been brought into play, as witness Blain's[2] article on penicillin in intestinal obstruction, and Lyon's[13] contribution on the antibiotics in general surgery. In potential, as well as actual infections, they should be given a thorough trial. We have used penicillin in obstructions for the past 2 years, and have begun using streptomycin in 1 to 3 Gm. daily dosages. Their actual value may not become apparent until comparative series reports are available.

In Part I of this Survey, the past 6 years, including the work done during the War years (1941 to 1946 inclusive), 448 cases have been studied in detail.

In Part II, the 14 years (1933 to 1946 inclusive) since the inauguration of a plan to study and treat intestinal obstruction 1,143 cases will be summarized and comparisons made.

Part I

A Statistical Survey of 448 Cases (1941-1946)

In arriving at a method to systematize our statistics we were impressed with the large number of colored patients in our records. In a community where the colored population averages around 40 per cent of the whole, the discrepancy between white and colored does not seem great. However, it should be kept in mind that the indigent colored comprise about 80 per cent of the hospital population. It is our impression that the colored man or woman will apply for aid and treatment later and delay longer in coming to the public hospital than will the white. The breakdown of white and colored patients is included in Table I.

TABLE I

Totals (1941 to 1946 inclusive)

Year	White	Colored	Male	Female	Cases	Recovered	Died	Mortality Pct.
1941	15	73	55	33	88	69	19	21.6
	(13 R)*	(56 R)						
	(2D)†	(17 D)						
1942	9	57	37	29	66	48	18	27.3
	(9 R)	(39 R)						
		(18 D)						
1943	15	73	49	39	88	70	18	20.4
	(13 R)	(57 R)						
	(2D)	(16 D)						
1944	6	66	41	31	72	42	30	41.6
	(3 R)	(39 R)						
	(3D)	(27 D)						
1945	9	55	38	26	64	46	18	28.1
	(8 R)	(38 R)						
	(1D)	(17 D)						
1946	13	57	36	34	70	50	20	28.5
	(11 R)	(39 R)						
	(2D)	(18 D)						
Totals	67	381	256	192	448	325	123	27.4
	(57 R)	(268 R)						
	(10 D)	(113 D)						
Mortality Rate	15%	29.6%						

*R—Recovered. †D—Died.

The overall mortality percentage of 27.4 includes all cases of acute intestinal obstruction. Not only small bowel obstructions, but also neoplastic, congenital, vascular and neurogenic obstructions of all types. Every patient admitted to the hospital, whether dead or dying on arrival is included, where a diagnosis made under a modified Wangensteen Classification may be tabulated. No effort was made to weed out cases under 24 hours or over 24 hours. A true story of the entire picture, in our estimation, is otherwise not obtainable. Further elaboration in Classification breakdown (Table II) will reveal other important factors bearing upon the apparently heavy mortality percentage. It will also be noted that the year 1944 bore a mortality rate 41.6 per cent which greatly affected the overall mortality percentage. In 1944 there was not only a dearth of attending surgeons at the hospital, but also of experienced residents, a sad commentary of a "War Year" duplicated in hundreds of public institutions throughout the country. It may also be noted that the mortality rate in the colored patients was twice that in the white.

CLASSIFICATION BREAKDOWN

TABLE II

Classification (Wangensteen) (Modified)	(1941)			(1942)			(1943)			(1944)			(1945)			(1946)		
I. Mechanical	No.	R.*	D.†	No.	R.	D.	No.	R.	D.	No.	R.	D.	No.	R.	D.	No.	R.	D.
(a) Neoplastic	6	2	4	6	1	5	9	1	8	5	3	2	3	1	2	6	0	6
(b) Fecal Impaction							1	1	0	1	0	1				1	1	0
(c) Gallstone Obstruction																1	1	0
(d) Congenital Bands				1	0	1				1	0	1						
Totals	6	2	4	7	1	6	10	2	8	7	3	4	3	1	2	8	2	6
II. Adhesive																		
(a) Postoperative	29	24	5	20	16	4	26	24	2	16	10	6	18	14	4	21	19	2
(b) Post-inflammatory	15	14	1	10	7	3	13	10	3	9	6	3	12	10	2	12	9	3
Totals	44	38	6	30	23	7	39	34	5	25	16	9	30	24	6	33	28	5
III. Vascular																		
(a) Herniae—Strangulated	32	25	7	15	12	3	29	24	5	32	17	15	27	20	7	14	11	3
1. Inguinal	25	20	5	10	9	1	19	17	2	24	14	10	20	17	3	8	6	2
2. Femoral	3	2	1	3	2	1	4	2	2	1	0	1	1	0	1	2	2	0
3. Incisional (Ventral)	3	3	0	1	0	1	2	2	0	6	2	4	5	3	2	2	2	0
4. Internal	1	0	1	1	1	0	2	1	1	1	1	0				1	1	0
5. Umbilical							1	1	0									
6. Epigastric							1	1	0							1	0	1
7. Diaphragmatic													1	0	1			

(b) Intussusception	3	2	1	10	8	2	8	8	0	3	3	0	1	1	0	6	4	2
(c) Volvulus	3	2	1				2	2	0	3	2	1	3	0	3	9	5	4
(d) Mesenteric Thrombosis				1	1	0				1	0	1						
Totals	38	29	9	26	21	5	39	34	5	39	22	17	31	21	10	29	20	9
IV. Neurogenic Adynamic Ileus				3	3	0				1	1	0						
Annual Totals	88	69	19	66	48	18	88	70	18	72	42	30	64	46	18	70	50	20
Percentage of Deaths	21.6%			27.3%			20.4%			41.6%			28.1%			28.5%		
	(1941)			(1942)			(1943)			(1944)			(1945)			(1946)		

CLASSIFICATION — MORTALITY RATES
(1941 - 1946)

	No. of Cases	Deaths	Percentage
I. Mechanical	41	30	73.1
II. Adhesive	201	38	18.9
III. Vascular	202	55	27.2
IV. Neurogenic	4	0	0.
Totals	448	123	27.4

*R—Recovered. †D—Died.

In Table II a modified Wangensteen Classification breakdown of the 6 year period of Acute Intestinal Obstruction is revealed. In Wangensteen's Classification the adhesive obstructions are classed under Heading No. I, which includes the heavy mortality group of neoplastic obstructions, congenital atresias, congenital bands, etc. We have removed adhesive obstructions because they often require observation and treatments unrelated to the neoplastic group, which are mainly colonic, whereas the adhesive group are mainly small intestinal.

The most impressive figure in this breakdown of classes is the mortality rate in the neoplastic group, where there were 27 deaths in 35 patients with a mortality of 77.1 per cent. The majority of these patients were either dying or moribund upon admission. In the bad "War Year," 1944, it will be noted that there were 9 deaths in 16 patients in the adhesive group and 15 deaths in 32 patients in the strangulated hernia sub-head. In these two groups the elapsed time from onset of the disease to hospital admission averaged 3 days. The Elapsed Time factor will be further elaborated.

The Age Factor

It will be noted in Table III that the average age of all patients was 40 years and 4 months. The recoveries averaged 37 years and 2 months, while those who died averaged 51 years and 2 months.

TABLE III

Age Averages

	Average Age	Average Age All Recoveries	Average Age All Deaths	Average Age Neoplastic Deaths Only
1941	38	36	50	59
1942	40	34.5	50	54
1943	38	36.8	52	59
1944	42	37.9	50.5	50.5
1945	40	36.4	49.5	54
1946	44	41	55	56
	242	222.6	307	332.5
Total Average	40 yrs. 4 mos.	37 yrs. 2 mos.	51 yrs. 2 mos.	55 yrs. 6 mos.

The heavy mortality in the neoplastic group is again evidenced by the average age of the patients who died of neoplastic acute obstruction.

That the elixirs of life are strong in the younger is revealed by the survival group who averaged 37 years and 2 months while 14 years separated their average from those who died, with an average of 51 years and 2 months.

The Elapsed Time Factor

In all papers written in recent years more stress is laid upon the elapsed time factor—from onset of symptoms to admission to the hospital—as being the most critical factor in the saving of lives. In Table IV this evidence is most convincing. Those patients who survived averaged 47½ hours from onset of symptoms to admission, while those who died averaged 71 hours.

TABLE IV

ELAPSED TIME

Onset to Admission

	Recovered	Died
1941	45½ hrs.	70 hrs.
1942	45	58½
1943	35½	73
1944	45	71½
1945	53½	80
1946	58	73
Total Average	47¼ hrs.	71 hrs.

The most obvious conclusion would be that definitive treatment should be instituted within 48 hours of onset to assure the best results. Apparently the third 24 hour period is the most critical.

In Table V a further breakdown reveals the convincing fact that patients with symptoms of 4 or more days' duration have not much better than an even chance for recovery.

In 21 moribund patients and critically ill patients, no accurate details could be obtained as to the onset of symptoms. It will be noted that 15 of these patients died.

TABLE V

1941 to 1946, Inclusive

Elapsed Time	Cases	Recovered	Died	Mortality
4 days or more	115	63	52	45.2%
3 days	46	35	11	23.9%
2 days	59	48	11	18.6%
1 day or less	207	173	34	16.4%
Undetermined	21	6	15	
Total	448	325	123	27.45%

Symptoms and Signs

As in all typical pictures of obstruction the most common factors in this series (Table VI): Abdominal pain, vomiting, constipation, distention and mass. The pain was mainly of a colicky nature rather than steady, in the majority of patients. Regurgitant (upper gastrointestinal) vomiting was by far the most outstanding symptom.

It should be noted that in 140 patients there was no history of obstipation on admission. However, in 153 patients there was moderate to severe distention of the abdomen. Mass was felt, upon physical examination, in 181 patients. Strangulated external herniae comprised the greatest number in this group. Tenderness, a danger sign of greatest import according to Wangensteen,[31] was present to a moderate or severe degree in 108 patients. Shock, pronounced, was present in 42 patients, of whom 20 died within 48 hours of admission in irreversible status.

Laboratory Findings

The most constant findings were those of hemo-concentration. In a general hospital of this type the average red blood cell count hovers about the 3 million mark, but the average count in this series revealed 4,360,000. The hemoglobin general average is approximately 11 Gm., but in this series it was 12.7 Gm. The plasma protein was in normal range. Urinary concentration was 1.023, which is high, as anticipated.

X-rays were reported—flat abdominal films—in 226 cases with 165 reported with positive findings of obstruction.

TABLE VI

SYMPTOMS AND SIGNS

(1941 to 1946) 448 Cases

Pain		Emesis		Obstip.*		Distention					Mass		Peristalsis		Tenderness			Shock	
Colicky	Steady	Regurg.*	Fec*	Yes	No	0	1	2	3	4	Yes	No	Aud.*	Vis.*	Mild	Mod.*	Sev.*	Yes	No
38	24	69		40	26	10	9	17	10	9	37	45	35	1	26	23	6	10	78
35	5	53	1	24	30	6	10	16	6	4	25	41	25	1	21	8	3	6	60
50	16	68	4	39	32	10	10	22	5	4	38	47	21	8	19	18	3	8	80
27	17	55	1	31	21	2	7	13	9	3	34	34	8	0	16	12	3	9	63
23	17	57	3	23	12		8	5	4		24	17	8	1	12	9	8	4	60
37	8	59	10	36	19	1	14	17	4	5	23	46	22	1	19	11	4	5	65
210	87	361	19	193	140	29	58	90	38	25	181	230	119	12	113	81	27	42	406

*Regurg.—Regurgitant. *Fec.—Feculent. *Obstip.—Obstipation. *Aud.—Audible. *Vis.—Visible. *Mod.—Moderate. *Sev.—Severe.

TABLE VII

LABORATORY FINDINGS

(1941 to 1946) 448 Cases

Blood			Chemistry				Urine	X-ray	
RBC	HGB	WBC	NPN	CHL	CO_2	Protein	Sp. Gr.	Pos.	Neg.
4.3 M	13.0 Gm.	12.2 T	53.0 Mg.	447 Mg.	43%	6.8 Mg.	1.026	24	19
4.3	13.0	11.7	60.0	447	49	5.6	1.025	31	4
4.3	12.5	12.2	75.0	472	43	5.5	1.022	33	8
4.3	12.0	12.1	47.0	472			1 022	31	7
4.4	13.0	11.9	49.0	447		7.8	1.024	17	10
4.58	12.8	12.2	51.5	439			1.022	29	13
26.18	76.3	72.3	335.5	2,724	135	25.7	6.141	165	61
Av. 4.36 M	12.7 Gr.	12.5 T	55.9 Mg.	454 Mg.	45.0%	6.32 Mg.	1.023		

Surgery

In Table VIII are the findings relative to surgical intervention: 355 of the 448 patients were operated upon while 86 were not. Of the 23 patients who died before surgery, all were dead within 48 hours of admission.

TABLE VIII

	Operations Performed	Anesthetic None	Gen'l	Spinal	Local	Elapsed Time Admission to Surgery	Deaths Before Surgery	After Surgery
1941	49	15	43	6	1	17.8 hrs	4	14
1942	75	13	30	46	3	27.4	2	17
1943	59	27	56	4		15.0	5	13
1944	56	16	51	5		25.5	6	24
1945	54	7	54	1		19.5	4	14
1946	62	8	52	12		15.5	2	18
	355	86	286	74	4	121.5	23	100
Average						20.25 hrs.		

Anesthesia Records

1941 to 1946— 74 Spinals with 16 deaths. Mortality rate, 21.6 per cent.

1941 to 1946—280 Generals with 80 deaths. Mortality rate, 28.9 per cent.

The elapsed time between admission to the hospital and surgery denotes mainly diagnostic but also therapeutic efforts on the part of the staff in properly evaluating the pathology present and the patient's optimum condition for withstanding surgical intervention. Herein lies the most important factor in surgical judgment. In this hospital, with a constantly rotating attending staff, no single surgeon carries the responsibility. As Eliason and Welty[6] so pointedly state: "Lower mortality is related, we feel, to improved methods of treatment and probably also to the fact that the surgery is performed by a relatively *small* group of men, all with adequate training or supervision."

There were but 76 spinal anesthetics administered with a mortality of 21.6 per cent (16 deaths). There were 80 deaths where

280 general (inhalation) anesthetics were used with a mortality rate of 28.9 per cent. It is our belief that spinal anesthesia should have been employed more often.

Operations

Of the critically ill patients, subjected to major surgery, resection was necessary (6 exteriorized only) in 64 (Table IX). Of these 37 died, with a resultant mortality rate of 57.5 per cent. Heroic measures, in those even more critically ill, consisting merely in enterostomy, were performed in 44 cases. Fifteen died with a mortality of 66 per cent. The mortality rate of 13.7 per cent in the great majority of operative procedures 247 out of 355 points the way for the ideal percentage obtainable, i.e.—when patients arrive early in their course of the disease, when proper evaluation is made by the attending and resident surgeons of the pathology present, and treatment, surgical or non-surgical, is promptly instituted.

TABLE IX

OPERATIVE RECORD

	Total No. of Cases	Operated Upon	Simple Lysis, etc.	Resection	Enterostomy	R.*	D.†
1941	88	75	51	12	12	58	17
1942	66	49	30	8	11	35	14
1943	88	59	38	15	6	46	13
1944	72	56	41	10	5	32	24
1945	64	54	40	11	3	40	14
1946	70	62	47	8	7	44	18
Totals	448	355	247	64	44	255	100
			(213 R)	(27 R)	(15 R)		
			(34 D)	(37 D)	(29 D)		
Mortality Rate			13.7%	57.5%	66%		
Overall Mortality Rate			28.2%				

*Recovered. †Died.

No Operation

86 Patients 63 Recovered 23 Died Mortality Rate, 26.7 per cent

Of these, 17 died in irreversible shock within 36 hours of admission; 3 died within 48 hours of admission in irreversible shock. Two died on the way to their wards, and one died in the Receiving Ward while being admitted.

An interesting commentary upon what is "liable" to happen following abdominal surgery is to be gathered from Table X. Of the 448 patients in the entire group, 162 had had one or more previous abdominal operations. There had been 216 abdominal operations previously performed upon these 162 patients. 36.1 per cent of these 448 returned to the hospital with acute intestinal obstruction with the previous operation or operations as a possible contributing factor!

TABLE X

PREVIOUS ABDOMINAL SURGERY

	Number of Patients	Number of Abdominal Operations
1941	34	46
1942	25	33
1943	32	48
1944	19	26
1945	22	29
1946	30	34
	162	216

In a previous series 59 cases were found in which an abdominal operation was found to be the cause of the obstructing signs and symptoms[26] (Table XI). Of these, 26 were pelvic operations upon the female internal organs and 21 were appendectomies.

TABLE XI

PREVIOUS OPERATIONS CAUSING OBSTRUCTION

Appendectomy	21
Pelvic Laparotomy	26
Gunshot Wound of Abdomen	3
Colostomy	3
Cholecystectomy	2
Previous Obstruction	2
Stab Wound of Abdomen	1
Herniotomy, Inguinal	1
	59

PART II

A Summary of 14 Years—1,143 Cases (1933 to 1946)

In 1933, under the direction of our Chief of Surgery, J. Lucius McGehee, we inaugurated Wangensteen's principles, in toto, in the treatment of all cases of acute intestinal obstruction. We are in full agreement with Wangensteen that all cases of obstruction have in common a number of cardinal factors not only in diagnosis, disturbed physiology and biochemistry, but also in treatment. For the use of the attending staff, as well as the resident surgical staff, the combined Clinical and Pathological Classification of Wangensteen,[30] modified to suit our needs, was inaugurated (Table XII). The only change worthy of note in Wangensteen's Classification and ours is the classifying of adhesives under a separate group heading. This change was made because of the great number of postoperative and post-inflammatory adhesions found in our first survey (1923 to 1932) when approximately 50 per cent of the entire group of 581 cases reported[6] were placed under this heading. It is our most dangerous group, since we find not only simple obstructions but strangulations as well. It is this group which receives more concentrated preoperative and operative attention than any other.

Before the inauguration of the Wangensteen plan, one of us (MJT) surveyed the records of the John Gaston Hospital from 1923 to 1932 inclusive, in an effort to establish a basis.[16] It was found that there were 581 cases of acute intestinal obstruction of all types in the Classification with 285 recoveries and 296 deaths (Table XIII). The overall mortality of 50.94 per cent, compared well with reports from numerous clinics and hospitals of similar clientele. Scudder[25] in 1908 reported a 58 per cent mortality. Richardson[23] in 1920 reported a 51 per cent mortality. As late as 1929, C. Jeff Miller[17] reported 343 cases with a mortality of 61 per cent. Bennett[1] is authority for the statement that an average mortality of 70 per cent was the rule in earlier days.

The lowest mortality percentage was 45.32 in 1931 and the highest was 60.7 in 1923. There were 109 white and 470 colored patients, with the mortality approximately twice as great (per centum) amongst the colored as compared to the white.

In the next table (Table XIV) are the figures computed since 1933 annually. The breakdown was not as complete in the 1933 to 1940 series as in the 1941-1946 series, although elapsed time was carefully tabulated in both series as will be shown. All cases were typed according to our Wangensteen modification from the moment

TABLE XII

Wangensteen (Modified) Clinical and Pathological Classification of Acute Intestinal Obstruction with an Outline of Treatment Indicated in Type Cases

Clinical Classification	Pathologic Classification	Treatment
I. Mechanical Narrowing of lumen due to: 1. Strictures of the bowel wall (a) Congenital (Atresia (Imperforate anus (b) Acquired (Neoplastic (Inflammatory (Traumatic 2. Obturation (a) Gallstones (b) Fecal Impactions 3. Compression from without (Tumors of pelvis, retro-peritoneum, etc.)	Simple (Excepting complete occlusions of the colon)	Operation, preceded by suction siphonage, fluid, electrolyte, plasma, blood and protein replacement therapy. In occlusions, with great distention, immediate operation.
II. Adhesive 1. Postoperative 2. Post-inflammatory	Simple or Strangulation	Suction and replacement therapy, then operation. Early operation in strangulation after rapid preparation.
III. Vascular 1. Hernia (a) External (b) Internal 2. Intussuception 3. Volvulus 4. Mesenteric Thrombosis and Embolism	Strangulation or strangulation-like	Early operation after rapid preparation (blood and plasma during operation).
IV. Neurogenic 1. Adynamic (paralytic) ileus 2. Dynamic (spastic) ileus	Simple	Suction, with replacement therapy.

TABLE XIII

SUMMARY OF 581 CASES OF ACUTE INTESTINAL OBSTRUCTION

(All types)
1923 to 1932, Inclusive.

Year	Cases	Recoveries	Deaths	Mortality Rate
1923	56	22	34	60.70%
1924	33	15	18	54.54%
1925	47	23	24	51.08%
1926	38	15	23	60.50%
1927	53	27	26	49.05%
1928	63	31	32	50.79%
1929	67	36	31	46.26%
1930	57	31	26	45.60%
1931	77	42	35	45.32%
1932	90	43	47	52.22%
Totals	581	285	296	50.94%

of admission to the Receiving Ward to discharge or death. The overall mortality for 14 years for the 1,143 cases was 26.07 per cent. There were 845 recoveries and 298 deaths.

The senior author recalls with great chagrin the sudden rise in mortality rate in 1939 after such an "excellent return" for efforts expended in the preceding 3 years when the mortality rate dropped steadily year by year from 19.3 to 17.3 to 12.7 per cent. We lost "something" in 1939 when the mortality rate actually doubled—25.4 per cent. Apparently we have not yet regained it. We have varied our treatment and preoperative preparation as new advances were made—particularly the use of blood and plasma, and more recently, amino acid therapy, vitamin therapy and the addition of penicillin and streptomycin. It cannot be due to the old method of using the shorter Levine tube instead of the Miller-Abbott tube, because we did not begin to use the Miller-Abbott tube until 1939. We believe that, though the mortality rate has dropped 50 per cent in 14 years, 50.94 to 26.07 per cent, there is still much room for improvement. We would like to attain the ideal minimum for the

TABLE XIV

THE RESULTS OF 14 YEARS OF APPLICATION OF THE NEWER CONCEPTS TO DIAGNOSIS AND TREATMENT
(1933 to 1946, Inclusive) 1,143 Cases

Year	Cases	Recoveries	Deaths	Mortality Rate
1933	51	31	20	39. %
1934	97	66	31	31.9 %
1935	47	27	20	42.5 %
1936	88	71	17	19.3 %
1937	98	81	17	17.3 %
1938	86	75	11	12.7 %
1939	114	85	29	25.4 %
1940	114	84	30	26.2 %
1941	88	69	19	21.6 %
1942	66	48	18	27.3 %
1943	88	70	18	20.4 %
1944	72	42	30	41.6 %
1945	64	46	18	28.1 %
1946	70	50	20	28.5 %
Totals	1,143	845	298	26.07%

indigent patient which should be somewhere between 10 and 15 per cent annually.

The Elapsed Time Factor

More than 50 per cent of the patients who died during this 14 year period came to the hospital 4 days or longer after the onset of symptoms. Approximately 25 per cent of those who died came to the hospital 2 or 3 days after onset of symptoms. The most encouraging figures, and those of greatest significance, are the ones concerned with the patients admitted with signs or symptoms 24 hours or less in duration: 555 patients were admitted in this group, of whom 497 recovered and only 58 died. The mortality rate—fitting into our overall "ideal percentage," in this group, was 10.45 per cent.

TABLE XV

ELAPSED TIME FACTOR

1933 to 1946, Inclusive

Elapsed Time	Cases	Recovered	Died	Mortality
4 days or more	315	160	155	49.2 %
3 days	119	83	36	30.2 %
2 days	133	99	34	25.6 %
1 day or less	555	497	58	10.45%
Undetermined	21	6	15	
Totals	1,143	845	298	26.07%

Acute Intestinal Obstruction in a Small Series of Private Cases

Just prior to the outbreak of the late War, one of us (MJT), in conjunction with his senior colleague in private practice, J. Lucius McGehee, over a period of 6 years, encountered 63 cases of acute intestinal obstruction of all types, according to the Wangensteen Classification. Table XVI reveals the findings, with an overall mortality rate of 7.8 per cent. In private practice, the responsibility and supervision in this instance narrowed to two surgeons, the ideal mortality rate should, naturally, be approached more readily. It is our opinion that even 7.8 per cent is still too high. But when one glances at the Elapsed Time Factor, the answer here, too, lies patently before us. In the 58 patients who recovered, the average elapsed time was 32 hours. In the 5 who died it was 5 days.

Of the 12 patients with adynamic ileus (neurogenic) all recovered. These included postoperative, traumatic and inflammatory adynamic ileus. We believe that, in private patients' series, the ideal mortality should dip below the 5 per cent mark. This will require more education and intelligent warnings for the lay public; in simple language, similar to our campaigns in combating the high mortality in acute appendicitis: unabated colicky or persistent abdominal pain of more than 6 hours' duration is a dangerous surgical sign. If it is accompanied by vomiting and obstipation, and there is a laparotomy scar upon the abdomen, a physician or surgeon should be sought immediately. The lower mortality rate in the private patients' series as McGehee[16] states: "is the result of several fac-

TABLE XVI

ACUTE INTESTINAL OBSTRUCTION

Private Series (McGehee & Tendler)
(6 Years)

	Number of Cases	Elapsed Time	Recovered	Died
Recovered	58	4 or more days	7	3
Died	5	3 days	5	2
Total Cases	63	2 days	15	0
Mortality Rate	7.8%	1 day or less	31	0
		Average elapsed time	32 hours	5 days

	Recovered	Died	
44 Cases operated upon	39	5	
19 Cases not operated upon	19	0	19 Cases were not
—	—	—	operated upon. All
63 Cases	58	5	recovered spontaneously

CLINICAL CLASSIFICATION

Type	Number	Recovered	Died	Per Cent Mortality
I. Mechanical	7	6	1	14.3
II. Adhesive	36	33	3	8.3
III. Vascular	8	7	1	12.5
IV. Neurogenic	12	12	0	
Totals	63	58	5	7.8

Deaths 5 — Average Elapsed Time—5 days

	Elapsed Time	
1 Mesenteric Thrombosis	3 days	Shock
1 Mechanical	5 days	Rupture of Colon—Peritonitis
3 Adhesive	1-7 days	Gangrene of Intestine
	1-3 days	Rupture of Intestine—Peritonitis
	1-7 days	Uremia

tors, namely, a more intelligent clientele seeking relief earlier—hence, an earlier diagnosis; secondly, the prompt application of a therapy in harmony with the present day knowledge of disturbed physiology by a small group."

Summary

1. A statistical critical review of 448 cases (1941 to 1946 inclusive) of all types of acute intestinal obstruction according to the Wangensteen Classification is presented (Part I).

2. A summary of our findings in 1,143 cases (1933 to 1946, inclusive) of all types of acute intestinal obstruction is also included. It summarizes all work done since the institution of the Wangensteen principles in our hospital.

3. A small group of private cases (63—a 6 year summary) is presented for study and comparison.

Conclusions

1. The mortality rate in acute intestinal obstruction of all types is still too high despite the vigorous application of our "Newer Concepts" of the diagnosis, the disturbed physiology and the definitive treatment of the disease.

2. "The poor we will always have with us." Hence, mass education of the lay public, similar to the campaigns Bower[4] and others applied to acute appendicitis, is highly desirable. "Unabated colicky or persistent abdominal pain of more than 6 hours' duration is a serious surgical sign. If it is accompanied by vomiting and obstipation and there is a laparotomy scar upon the abdomen, a physician or surgeon should be sought immediately." The most critical factor in the saving of lives is the Elapsed Time factor—the time from onset of symptoms to admission to the hospital. To assure the best results definitive treatment should be instituted within 48 hours of onset of symptoms.

3. The "ideal minimum" mortality rate in indigent patients should lie between 10 and 15 per cent. In private patients it should be below 5 per cent.

4. The critical factors in obstructions are:

(a) In high obstructions: azotemia, hemoconcentration, loss of essential fluids and electrolytes due to vomiting.

(b) In low obstructions: damage to the bowel wall, caused by increased intraluminal pressure, with increased permeability and

ultimate migration of bacteria and other noxious agents through its wall, or actual rupture of the wall.

(c) In strangulations (vascular lesions): the threat to the viability of the bowel wall is gravely acute; also the blood and plasma loss may be great.

5. The essential features in treatment are:

(a) The immediate establishment of suction siphonage of the stomach and upper intestinal tract by nasal tube as soon as the diagnosis of acute intestinal obstruction is made.

(b) The immediate restoration of lost fluids, electrolytes and protein (blood, plasma, amino acids as indicated) by the parenteral route. This restoration should be carefully estimated not only by the clinical picture but also by the use of quickly obtained laboratory tests.

(c) Operative delay should not be countenanced if pain is not relieved after decompression is well under way. Tenderness is a danger sign also. Increase in pulse rate, another.

(d) Asepsis is a critical factor in the surgery of acute intestinal obstruction, whether simple enterostomy or intestinal resection is performed. Spillage is often fatal.[31] Intra-abdominal sulfonamides or antibiotic solutions are recommended as prophylaxis as well as therapeusis.

(e) The institution of the sulfonamides (sodium sulfadiazine, intravenously), penicillin and streptomycin in adequate dosages postoperatively.

(f) The continuation of suction-siphonage during surgery and postoperatively until distention is relieved and colonic evacuation has begun.

(g) The continuation of fluid, electrolyte and protein replacement postoperatively, until balance is restored and the patient receives adequate oral replacements.

(h) The judicious use of morphine (gr. 1/8 to 1/6) every 3 or 4 hours, as well as small warm mineral oil enemata (6 to 8 ounces) every 12 hours, to aid peristalsis and to combat postoperative ileus.[21,22]

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MANAGEMENT OF THE HYPERTHYROID PATIENT

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TREATMENT INDICATED

WITH the introduction of thiouracil in 1943, it was hoped that a satisfactory medical treatment for hyperthyroidism had been found and that surgery would no longer be necessary.

Time and accumulated experience, however, have shown that all of the antithyroid drugs—thiouracil, thiobarbital, and even propyl thiouracil, are too toxic for prolonged and unsupervised use. Also, none of these drugs reduce the size of the thyroid sufficiently to relieve pressure symptoms and all are followed by a very high incidence of recurrence of the hyperthyroidism as soon as their use is discontinued.

Undoubtedly, the cause of hyperthyroidism will ultimately become known and then some harmless drug will probably be developed that will arrest the disease before symptom-producing enlargement of the thyroid gland has occurred and the necessity for surgery will be greatly reduced or eliminated.

That day has not yet arrived, however, and it is the opinion of all who have had much experience with this disease that at the present time the most satisfactory treatment for thyrotoxicosis is adequate subtotal thyroidectomy in a properly prepared patient.

RESULTS SECURED BY SURGERY

In evaluating the results of any surgical procedure, the mortality rate, the incidence of postoperative morbidity, and the percentage of permanent cures that may be expected to follow the operation, should be considered. So many operations for hyperthyroidism have now been done that quite definite answers can be given to these questions.

The average mortality rate for 44,897 subtotal thyroidectomies for all types of hyperthyroidism as reported in the literature is 1.43 per cent.[1,2,3,4,5] Our mortality rate for the past 10 years is 1.2 per cent, and we have now done 263 consecutive operations without a death.

Only 3 postoperative complications capable of producing permanent discomfort are likely to follow subtotal thyroidectomy. They

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are injury to the recurrent nerves, parathyroid tetany, and postoperative hypothyroidism.

Fear of injury to both recurrent nerves with a loss of the patient's ability to speak is, in our opinion, the chief cause for incomplete operations and persistent or recurrent hyperthyroidism.

This danger can be largely overcome by the routine demonstration of the recurrent nerve as it passes through the operative field and by eliminating excessive bleeding by ligating the trunk of the inferior thyroid artery before proceeding with the gland resection. We have routinely employed this technic for the past 3 years and during this time have not had a recurrent nerve injury.

Parathyroid tetany can be positively prevented by demonstrating and protecting at least one parathyroid gland during the operation. If unable to find a parathyroid (we fail to demonstrate a parathyroid gland in about 15 per cent of cases), tetany will probably be prevented by resecting the gland in such a manner as to leave unremoved a considerable part of the capsule of the lateral and posterior surfaces of each lobe, especially at the point where the inferior artery joins the gland.

As a further precaution, each specimen is carefully inspected before leaving the sterile table and, if a parathyroid is found, it is transplanted into one sternomastoid muscle.

In our last 263 cases we have had one case of tetany and she is kept symptom-free by the oral administration of viosterol and calcium.

Our chief aim in operating on patients with hyperthyroidism has been to produce a permanent cure with the smallest possible incidence of recurrence of the disease. Therefore, we do a very radical subtotal thyroidectomy and leave only a very small remnant of each lobe.

Consequently we find some evidence of postoperative hypothyroidism in a certain number of our patients. However, most of these patients are comfortable with the daily administration of thyroid extract and we do not feel much concerned about postoperative hypothyroidism.

The recurrence rate for hyperthyroidism following subtotal thyroidectomy in 8,141 cases as reported in the literature by various surgeons[4,6,7,8,9] is 5.68 per cent. During the past 3 years, 6.6 per cent of our operations for hyperthyroidism have been recurrent cases.

Preoperative Treatment

A general history, physical examination, urinalysis, complete blood count, basal metabolism and, when indicated, electrocardiogram, are done at the initial visit. The surgeon's impression as to the severity of the disease and the operative risk involved is recorded at this time. (We feel very strongly that the patient should be seen by the surgeon before detoxication therapy is started and that he should be primarily responsible for this most important phase of the treatment.)

Unless the patient is a thyrocardiac with decompensation or fibrillation, bordering on a crisis, or has some other serious complicating condition, he is treated as an out-patient and not admitted to the hospital until just a few days before operation.

Until recently we reserved thiouracil for the more toxic cases and continued to prepare all mildly toxic patients with Lugol's solution. We now prepare all patients having hyperthyroidism, even though the disease is mild, with propyl thiouracil and iodine. (We have now used propyl thiouracil in 27 cases and consider it definitely less toxic than thiouracil.) Two hundred milligrams of propyl thiouracil in 4 doses is given each day until the hyperthyroidism has been relieved. It is discontinued a few days preceding the operation. Iodine in the form of Lugol's solution, 10 drops 3 times a day, is given during the 3 weeks immediately preceding operation. In addition, most patients are given a half grain of phenobarbital several times a day as needed for sedation.

We ask all patients to discontinue regular work and to spend a great part of each day resting in bed. Visitors are limited and a diet high in protein and carbohydrate is given.

Patients are observed once a week, at which time a record is made of the weight, pulse, white and differential blood count, and inquiry made as to fever, headache, nausea, vomiting, abdominal pains, skin rashes, edema, and joint pains. Basal metabolism tests are done each 2 weeks.

If no toxic signs are noted, treatment in this manner is continued until the patient is considered operable. Propyl thiouracil is stopped the day the patient enters the hospital, but Lugol's solution is given orally until a few hours before the operation and continued intravenously during the immediate postoperative period.

Determination of Operability

In general, we consider patients ready for operation when they

have shown a gain in weight, when the pulse has become stabilized at a normal rate, when nervousness and activation have disappeared, and when the basal metabolic test has returned to normal. The average gain in weight in our last 100 cases was 18.4 pounds. The average initial pulse rate was 120.4 with a decrease to 85.6 before operation. The basal metabolic rate averaged 48.1 at the beginning of treatment and 2.7 at the last test before operation.

Whenever any doubt exists as to the patient's operability, we continue treatment for a while longer. This policy has without doubt caused us to treat some patients longer than is necessary but by so doing we have completely eliminated postoperative hyperthyroid reactions.

Technic of Operation

It seems rather elementary to say that good thyroid surgery cannot be done unless the patient is in the proper position, unless the patient is well anesthetized, unless the operative field is properly illuminated, and unless adequate trained surgical assistants are available, but we have so often seen a capable surgeon fail because of a lack of one of these essentials that we feel obliged to mention these prerequisites.

Very few operating tables, when received by the hospital, are equipped with a thyroid bar, but nearly all have side rails onto which an elevator can be attached. This allows the bar to be moved up and down on the table and properly adjusted to patients of varying heights. If the operating table is adjusted so that the patient is maintained in a slight sitting position and the thyroid bar is placed under the upper chest, a very good exposure of the thyroid gland is secured as the bar is elevated.

Good anesthesia means quiet respiration with a clear air-way and this, in our experience, can best be secured by an endotracheal tube and we no longer reserve its use for the large goiters producing demonstrable tracheal compression but employ endotracheal anesthesia in all cases.

No matter how good or expensive the overhead light, it is never adequate for the best vision and, in addition, one or more spotlights should be used and so arranged that the focus can be centered on the region of the recurrent nerve and inferior thyroid artery.

The need for a first assistant and instrument nurse experienced and familiar with the technic of thyroid surgery is imperative and we feel sure that we could not keep our mortality rate at its low

level if we had to operate with an inexperienced interne and a student nurse.

The technic that we employ is the one developed and taught to us by Frank H. Lahey and can be found illustrated in numerous publications.[10]

The essential steps consist of a gently curved incision of adequate length for good exposure, so placed that the resulting scar falls at the base of the neck. The flap is raised between the platysma and cervical fascia to well above the notch of the thyroid cartilage. Both sternomastoid muscles are mobilized, the prethyroid muscles separated in the midline, and divided high between clamps. Vertical incisions are then made from the lateral end of the transverse muscle, cut so that the muscle flaps may be carried upward and downward as far as is necessary to uncover completely both the superior and inferior thyroid poles.

The superior thyroid vessels are doubly ligated and divided. The lateral thyroid veins are divided and the entire lobe is rolled medially so as to expose the trunk of the inferior thyroid artery and the recurrent nerve.

The inferior artery is tied in continuity. The nerve is isolated and traced upward to the spur of the thyroid cartilage where it becomes intralaryngeal. Search is made for parathyroids and the amount of gland to be resected is outlined by a row of hemostats.

Next, the isthmus is raised and detached from the opposite lobe, completely removing the isthmus from the front of the trachea. The lateral lobe is then resected, care being taken to bevel the gland so that the small remnants will fold easily to the pretracheal fascia, eliminating thereby raw surfaces and completely controlling bleeding from the gland.

The surgeon changes sides, removes the opposite lobe in the same manner, and closes the neck in most cases with a drain drawn through the sternomastoid muscles.

Postoperative Care

Thyroid patients require the same postoperative care as other surgical patients and, in addition, must be carefully watched for respiratory obstruction, hemorrhage, and hyperthyroid reactions.

Laryngeal spasm, nerve injury, postoperative edema of the larynx, collection of mucus, and compression of the trachea by hemorrhage, are the main causes of postoperative obstruction to the air-way. Laryngeal spasm will be practically eliminated by the

routine use of the endotracheal tube. Mucus can usually be removed by proper catheter suction. Tracheal compression due to hemorrhage will be relieved when the clots are removed. Edema will often be relieved by steam inhalations.

Whatever its causes, the obstruction must be relieved. We have never seen a death, a serious wound infection, or tracheal stenosis follow tracheotomy and we feel that many lives are lost by hesitating to perform this simple operation.

Hemorrhage is a distressing postoperative complication but a fatality will usually be prevented if the neck is immediately reopened and the bleeding point ligated.

We have not seen a postoperative hyperthyroid reaction since we began to prepare all toxic patients with thiouracil or propyl thiouracil, but if there is any indication that the pulse or temperature are becoming abnormally elevated, the patient is immediately placed in a motor-driven oxygen tent delivering 7 to 8 liters of oxygen per minute, a constant infusion of glucose at about 40 drops per minute is started, 20 drops of Lugol's solution is put into each liter of the intravenous fluid, and morphine or barbiturates are administered as needed for sedation.

Ordinarily patients are allowed out of bed as soon as they feel like sitting up (24 to 48 hours), all of the clips are out on the second or third day, the drains are removed on the fourth or fifth day, and the patient leaves the hospital by the end of one week.

However, care of hyperthyroid patients does not end when they leave the hospital. All are instructed to have plenty of rest and to avoid stimulation, fatigue, and pregnancy for at least the first year after operation. All return for a basal metabolism test and general survey each 3 months for the first year and once a year thereafter until it is definitely established that a clinical cure has been secured.

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NEW HORIZONS IN THERAPEUTIC NERVE BLOCK IN THE TREATMENT OF VASCULAR AND RENAL EMERGENCIES WITH CONTINUOUS CAUDAL AND CONTINUOUS SPINAL ANALGESIA AND ANESTHESIA

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THE first century of the application of anesthesia in the conquest of pain has been completed. Organic ethers and chloroform, explosive and non-explosive gases, coca and synthetic alkaloids, barbiturates and alcohols, ice, and curare have been used in anesthesia by dentists, doctors, and nurses, who have achieved a victory over pain that has been the spearhead of the advance of modern surgery and the foundation of present day study and understanding of physiology.

The year 1947 begins the second hundred years of anesthesia, yet at the same time it completes the centennial of the control of pain in the birth-room.

General anesthesia through central nerve cell narcosis has been declared "The greatest gift America has given the world." Textbooks in all languages have described its technics, its virtues, its attendant alteration of body physiology and metabolism, and its potent dangers. For one hundred years science has sought to improve and perfect both technics and drugs for its safe application.

Conduction anesthesia through peripheral axon block of nerve impulses is fifty years younger, but of no less significance in the alleviation of suffering. However, since conduction anesthesia is regional or somatic or segmental, it is used to eliminate pain at its source of origin rather than to obtund its central interpretation. With its application, those areas of the body and those organs with innervation not affected by its contingent nerve depolarization, are spared a primary effect upon their metabolism and physiology.

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Both forms of anesthesia have been used primarily to control and to obliterate the impulses of pain. Yet many have observed that when pain is obliterated by anesthesia there are altered functions of glands and viscera, blood vessels and heart, lungs, and skin.

It is the purpose of this paper to direct attention to a study of these altered functions as influenced by conduction anesthesia. Even though they are by-products of pain control with anesthesia, they present to the medical profession, and to the patient, a new horizon in therapeusis.

It is significant that the first spinal anesthesia, produced by A. J. Corning of New York, was a therapeutic nerve block. The control of pain of this nerve block was so outstanding that others who utilized the procedure became distracted from the therapeutic and diagnostic approach afforded by the technic. Thus, therapeutic nerve block has always played a lesser role in comparison with the absolute obliteration of conduction pain.

Erlanger and Gasser have already been recognized for their fundamental studies in nerve conduction which have proved the anatomic dissociation of nerve axons which transmit pain, thermal, touch and pressure, vasomotor, proprioceptive and motor impulses. They, and Bishop and O'Leary, have determined that these specialized nerve components differ in their respective individual quantitative protection afforded by myelin insulation. The vulnerability of the non-myelinated pain and vasomotor fibers which are blocked earlier, more intensely, and longer than the larger motor components is the prime mechanism of the therapeutic nerve block.

Experience with 15,000 patients under spinal, caudal, paravertebral, presacral, peridural, and sympathetic ganglion anesthesia, clearly convinces one of the cardinal role that is played by the peripheral vascular bed when it is subject to temporary conduction denervation. No one can watch a hypertensive, eclamptic, comatose, convulsant patient in acute heart failure and pulmonary edema, rescued within 30 minutes by a therapeutic continuous caudal or continuous spinal anesthetic, which frequently lowers the blood pressure 100 mm. of mercury, and simultaneously relieves headache and blurred vision, raises the skin temperature of the feet 30° Fahrenheit, diminishes near fatal pulmonary edema, slows and steadies the failing heart, increases renal output, and coincidentally abolishes pain, without appreciating that in this mechanism lies one of the most potent weapons the physician possesses to wage against disease and death.

Digitalis, long classified as one of the ten vital pharmaceuticals,

oxygen, with all its power, and the myriad of analeptic wonder drugs, cannot rescue premoribund, heart failure patients in acute emergencies of pulmonary edema, with more beautifully swift regularity than does well-controlled, high segmental therapeutic nerve block.

Pitkin, in 1928, emphasized the use of spinal anesthesia in hyperbaric solutions containing glucose to produce a saddle-type of block in obstetrics. In his series of cases were several patients with severe heart disease who seemed to be protected from strain and exertion with spinal anesthesia. Cosgrove, in 1937, stated, "Spinal anesthesia in obstetrics is far safer for handicapped patients, those with bronchitis, pneumonia, tuberculosis of the larynx or lungs, thyroid disease, heart disease, especially if decompensated, diabetes, nephritis, and pregnancy toxemia. If its availability were limited to these classes of cases alone, its place in the obstetric armentarium would be important and secure."

In 1943 Edwards and Hingson[2] reported, "We were impressed early in our series with the well-being of cardiac patients under continuous caudal analgesia. There are certain physiologic phenomena which add to the burden of a diseased heart during the process of natural labor: (1) the emotional strain of the patient often associated with cries of pain; (2) fear of what the next few hours will bring forth; (3) tachycardia; (4) voluntary straining. All these increase the demand on a diseased heart. In some cases, an actual decompensation and permanent myocardial damage develop. The stress and strain of labor has been known to account for anoxemia which would contraindicate a general anesthetic.

"The patient under continuous caudal analgesia, however, is at ease, and does not need her voluntary expulsive efforts, . . ." In our series we have had two grade 4, three grade 3, and eight grade 2 cardiac patients who have done exceptionally well under continuous caudal analgesia. All of them delivered, without mortality or morbidity, live babies who cried spontaneously.

Since 1943 the number of patients with cardiac disease whom we have managed with continuous caudal and continuous spinal analgesia has increased to 85. In this series there have been no maternal deaths.

In 1944 Sarnoff and Farr,[1] in Rovenstein's Clinic in New York, treated 3 white males with moderate pulmonary edema accompanying acute heart failure with 125 to 175 mg. doses of procaine, administered as a spinal anesthetic to produce a bloodless phlebotomy pool of blood in the lower extremities, equivalent by measurement

to the withdrawal of 720 c.c. from the remainder of the circulating volume. In all of the cases a demonstrable improvement was immediately established within a few minutes. None of these patients had secondary relapse during the reported hospitalization.

Dripps[3] of Pennsylvania has stated, "Spinal anesthesia, by pooling blood in the periphery, by dilating veins and decreasing venous pressure, can be regarded as a bloodless phlebotomy, a procedure indicated in heart failure with mitral stenosis. . . . By the same reasoning, spinal anesthesia may be employed in the therapy of pulmonary edema. With such a method of treatment, diminution of venous pressure can be accomplished without a reduction of hemoglobin. This may be of importance in patients with low hemoglobin levels. Only a few case reports are available and the technic must be regarded as experimental."

Both of these latter authors have called attention to the beneficial effect of single doses of spinal anesthesia in cardiac failure with pulmonary edema. However, the experience of both of them with this method has been so small that they have not been faced with the emergencies that may arise directly as a result of the recovery period of the spinal anesthetic, which might permit the angiospastic mechanism of the sympatheticomimetic nerve impulses again to predominate. We have observed this mechanism more than a score of times in which, following spinal anesthesia and caudal analgesia, the blood pressure rose to dangerous levels of more than 200 mm. of mercury systolic, headache developed, and increased venous pressure initiated a secondary collapse of the peripheral veins. In cases with heart failure, this mechanism might prove to be fatal. Likewise, we have utilized the therapeutic nerve block to overcome the immobility of paralytic ileus. In several cases peristalsis immediately ensued—then, in the recovery period the sympatheticomimetic mechanism predominated with even a more alarming degree of ileus than had been first observed. This would account for the cases with paralytic ileus which develop postoperatively after the use of spinal anesthesia. The treatment of either of these conditions would not be a condemnation of the regional nerve block, but rather an indication for the continued controlled application of the block for as long into the recovery period as necessary.

The following case history illustrates the fallacy of single injection therapeutic nerve block, and the advantage of continued control of the vascular bed with the nerve block until the heart can adjust itself to the emergency.

Case Reports

Mrs. F. W., age 26 (Case 9), white primigravida, at seven and one-half

months of gestation, began developing edema of the extremities, an increase in albumin in her urine, a blood pressure elevation to 150/100, and shortness of breath on exertion. The general practitioner confined her to her bed after the third day of symptoms, whereupon she suddenly developed a convulsive seizure, cyanosis and shortness of breath. She was given one quarter grain of morphine, magnesium sulfate intramuscularly, and two cat units of digitalis by vein. She remained semi-comatose. Her blood pressure rose to 180/120, the pulse rate to 120, and the cyanosis deepened. She was then transported by ambulance to the hospital one hundred miles away. En route she had several choking spells, and remained in extreme cyanosis in the orthopneic position.

Upon hospital admission, she was in a pre-moribund state, with a chest full of rales that could be heard several feet from the patient. She was coughing up a foamy froth, was still unconscious, and occasionally semi-conscious, and in great distress. Her blood pressure was 190/126, pulse 120 to 130, and a gallop rhythm was present. Oxygen was immediately administered, yet she was still cyanotic and 4 plus pitting edema was present. Her heart was enlarged to the left nipple line. The fetal heart tones were not elicited after several attempts.

Intravenous aminophyllin, magnesium sulfate, and more intravenous digitalis did not alter the pre-moribund state. A small quantity of dark red urine was obtained by catheter and was found to be loaded with albumin and red blood cells. A diagnosis of eclampsia, acute heart failure, and severe pulmonary edema was evident.

Continuous caudal analgesia with 1.5 per cent metycaine through a ureteral catheter was instituted. Within ten minutes the patient's respirations were reduced in number from 40 to 30 per minute, her cyanosis began clearing, and the moist rales, formerly heard even in the apices of the lungs, were heard only in the bases. Within one hour she was mentally clear and comfortable during oxygen inhalations. Her blood pressure was reduced to 108/70, and was maintained within this range for several hours. Since she was not in labor, the level of nerve block was permitted to drop after five hours of treatment. Again, she developed the same symptoms of pulmonary edema, peripheral angiospasm and cyanosis, and blood pressure rise, so that it was necessary to re-institute high thoracic 9 segment caudal block to the ninth thoracic segment, whereupon all signs again immediately disappeared.

Nine hours after admission she suddenly had a hemorrhage of 1000 c.c. of blood from the vagina. A diagnosis of placenta previa was made by vaginal examination, which revealed an elongated, undilated cervix. In spite of the hemorrhage, the blood pressure again climbed to 170/120 mm. of mercury, with an attendant pulmonary edema. The angiospastic mechanism predominated because the anesthesia was temporarily withheld. This anesthesia was re-instituted as soon as whole matched blood could be administered as a transfusion, and a low cervical cesarean section was performed. Although no fetal heart tones had been elicited for 4 hours, a living 4 pound premature infant was delivered, which cried immediately, and which has survived. The patient had much less respiratory distress with a hypotension of 90/60 mm. of mercury during the operation, and the maintenance of the anesthesia to the 10th thoracic segment, than during the episode of hypertension immediately following the hemorrhage.

Continuous caudal analgesia was necessarily continued for the next twenty hours, with about 30 c.c. of 1.5 per cent metycaine being administered each

hour. The level of analgesia, however, began dropping from the umbilical level to low abdominal levels, and then only sacral levels could be maintained. The previously distended veins of the legs collapsed, cyanosis deepened, dyspnea became extreme, a general cold sweat ensued, and pulmonary edema became critical, requiring two attendants to hold the patient in the extreme orthopneic position. The blood pressure rose to 180/130, and a gallop rhythm was definite. Intravenous morphine, positive pressure oxygen, and amyl nitrate inhalations did not alter the picture.

Accordingly, a Tuohy 15-gauge spinal needle was inserted between the third and fourth lumbar spines into the subarachnoid space, and a No. 3½ ureteral catheter was inserted alongside the spinal cord to the sixth dorsal segment. One c.c. of .15 per cent pontocaine was administered, and the patient

Fig. 1. ***Case 4.*** **Complete anuria for 6 days. Patient under oxygen tent, with nasal tube intact. Patient unconscious and convulsive. Not more than 1 c.c. of fluid given by mouth or by vein during one 24 hour period. Concentrated glucose 50 c.c. intravenously every 4 to 5 hours. Solution of bicarbonate of soda, 10 per cent, 6 ounces, given by nasal tube and by catheter until urine was secreted and showed to be alkaline, then discontinued.**

again recovered within ten minutes to her best state of well-being, which she maintains until the present, on the fifteenth postoperative day. The continuous spinal anesthesia was maintained at the rate of 1 to 2 c.c. of pontocaine (1.5 to 3 mg.) every hour, and then every 2 hours. Finally, it was discontinued after 48 hours, since the patient's output of urine was normal, edema had subsided, heart compensation was established, and the blood pressure was 130/80. The catheter was maintained in position as a precautionary measure for 2 more days, or, for a total of 4 days. There has been no headache and no evidence of backache or neuropathy.

CASE 4: The patient was a white male, age 13, who was hospitalized on March 5, 1946, with right upper lobar pneumonia. He responded to treatment with sulfathiazole in conjunction with penicillin. There was evidence of suppression of urine on March 8. On March 12 at 3:00 a.m. he suffered his first convulsion, and thirty minutes later had his second seizure. Sodium amytal, gr. 7½ was administered intravenously and repeated in 2 hours. One liter of saline with 5 per cent glucose was administered subcutaneously.

Throughout the day supportive therapy, including bladder irrigations with 10 per cent sodium bicarbonate, intravenous penicillin and other measures did

Fig. 2. Same patient shown in Fig. 1, following caudal puncture, which was continuous from 9 p.m. on March 12 to 1:10 a.m. on March 13: 150 c.c. metycaine, 1.5 per cent solution given. Anesthesia maintained above umbilicus by prick of pin. First urine 3 c.c. obtained at 12:30 a.m. March 13, and submitted to laboratory; 6 ounces at 8:00 a.m.; 10 ounces at 10:00 a.m.; 147 ounces urine secreted during first 12 hours. First urine showed small tabs of mucus membrane, size of No. 8 shot. Probably from ureters due to edema and necrosis. Very little sulfa crystals felt in these tabs. Many tabs passed throughout the day. Obstruction due to mucus membrane tabs rather than crystals. Precipitation of few sulfathiazole crystals, but many mucus membrane plus. During first 24 hour period (8:00 a.m. March 13 to 8:00 a.m. March 14) 294 ounces of urine passed.

Fig. 3. *Case 4.* Specimens of urine passed by this patient during the first 12 hours following sympathetic block with metycaine.

not change his course. He had several more convulsions, became cyanotic with labored respirations, and developed coma with a temperature of 103 degrees. The absolute anuria persisted, and the blood pressure remained between 148/110 and 138/100. He was placed in an oxygen tent at 8:00 p.m. At 9:15 p.m. March 12 continuous caudal analgesia was administered and maintained for four and a half hours. At 12:35 a.m. March 13, the patient voided 3 c.c. of urine. Eight hours later the patient had voided 6 ounces of urine, and was improving in every respect. He voided 147 ounces of urine during the first 12 hours after continuous caudal block. He has made a complete recovery. (This patient was managed by Dr. James M. Barnett, of Albany, Georgia, whose good clinical result encouraged us to use this and allied methods of nerve block in the other children reported in this series.)

In 4 cases of acute nephritis in children, 3 of whom are being reported elsewhere,[5] continuous caudal analgesia was used as an adjunct in therapy in order to reduce arterial hypertension. Excessive elevation of blood pressure in acute nephritis is regarded as dangerous from two standpoints: (1) it may, possibly in conjunction with changes in the myocardial fibers, precipitate cardiac failure, and (2) severe vasospasm of cerebral arterioles, probably associated with the hypertension, may produce anoxia of brain tissue and lead to cerebral manifestations commonly called hypertensive encephalopathy. These manifestations range from headache, restlessness, and dimness of vision to sudden blindness, coma, and generalized convulsions, possibly ending in death.

The first child (Case 2) who had a hypertension of 200/180, was comatose, had severe cardiac failure with pulmonary edema, and seemed moribund, made a dramatic recovery as soon as caudal analgesia was instituted. In spite of the rising blood pressure having failed to respond to the usual methods of injections of magnesium sulfate and other measures, her pressure fell from 200/180 to 140/110 within 15 minutes after caudal analgesia was begun. Fifteen minutes later, without further caudal injection of metycaine, it was 130/100. The child awakened within a few minutes, breathed more easily, talked rationally, and dropped off into a quiet slumber without the least dyspnea. She made a rapid and uneventful recovery.

The second child (Case 3) had almost complete anuria, uremia, rapidly progressive anemia, extreme hypertension, cardiac failure, and generalized convulsions. She responded to caudal analgesia with a prompt reduction of hypertension, but the effect could be maintained for only one hour. Thereafter, her blood pressure went out of control and she subsequently died. Diuresis was not stimulated by caudal analgesia.

The third child (Case 11) had total anuria, uremia, rapidly progressive anemia, hypertension, cardiac failure, and generalized convulsions. Moderate diuresis followed immediately upon the institution of continuous caudal analgesia, and the blood pressure was repeatedly reduced by the method. However, the uremia became more progressive and the anemia most severe. This patient died.

The fourth child (Case 10) did not respond well to caudal analgesia, probably because it was not possible to raise the level of analgesia as high as is

usually employed in these cases. The blood pressure responded initially with a slight systolic drop, but this was not maintained. This case may be regarded as one in which for some reason it was impossible to achieve a high enough level of nerve block, in spite of the use of customary doses of metycaine. Technically, the procedure was a failure. However, the patient made an uneventful recovery, apparently not related in any way to the attempt to give continuous caudal analgesia to a satisfactory level.

From this small series of 4 cases of acute nephritis in children it may be seen that, when successful levels of analgesia were achieved, as they were in 3 of the cases, a reduction of hypertension followed. In the first case this prompt reduction apparently saved the life of the patient. In the second case reduction of blood pressure could be maintained for only one hour. In the third case the blood pressure was repeatedly and easily controlled with regularity by means of the procedure, although the patient went ahead and died of uremia and extreme anemia. In the fourth case a technical failure occurred. The fact that 3 of the 4 cases represented the most severe types of acute nephritis loads the mortality rate against caudal analgesia as a method of treatment, since 2 of the 4 patients died. The fact that the hypertension of two of the patients responded most satisfactorily to the procedure gives hope that this method may prove of value in acute nephritis when critical hypertension fails to respond to magnesium sulfate and other measures, and when cardiac failure or hypertensive encephalopathy are present. Caudal analgesia is suggested as a procedure to be used as an adjunct to other established therapy in acute nephritis, and more particularly to reduce extreme hypertension. Whether, by increasing blood flow to the diseased kidneys, it may minimize renal damage remains for further studies to show.

In addition, we have repeatedly lowered the moderately high blood pressure of a 25 year old male with diabetes, glomerulonephritis, and anuria, for a period of 5 days. This makes a total of 35 patients treated in these critical episodes. Twenty-five are still living. One patient, whose case will be immediately presented, was treated for 10 days and 6 hours with continuous spinal therapeutic block anesthesia. During this time her critical hypertension was reduced 114 times.

Case 8. Dec. 25, 1946, Diagnosis:

1. Furuncle, acute, right nose, lateral wall, high up.
2. Early right cavernous sinus thrombosis.
3. Pyuria secondary to (1) or (2) or both.
4. Acute glomerulonephritis with oliguria, and anuria, severe, secondary to (1) and (2).

This was a patient of Dr. J. A. James and of Dr. John D. Hughes, of Memphis.

December 18: Illness began for this 54 year old white female. Her right eye, which was being treated for pain by a private physician, became rapidly worse, very red, swollen, tender, with severe pain.

Fig. 5. *Case 8.* Patient shown 3 weeks after treatment for 10 days and 6 hours with maintained continuous spinal anesthesia with the Touhy ureteral catheter technic. At no time during or after treatment did patient have a headache. Her critical hypertension associated with anuria and pulmonary edema was reduced by this technic 114 times.

December 20: Chills, fever, pain and stiffness in the neck developed.

December 21: As the condition continued to get worse, this patient was taken to the hospital in Kennett, Mo., where penicillin was started. However, the supply ran out, and it was received for less than a day.

December 24: During her stay in the hospital, the patient's condition failed to improve. Penicillin was started again on the 24th. Some dysuria developed.

December 25: The patient was taken by ambulance to a larger hospital in Memphis. At this time she was acutely ill. Upon admission her mental state was found to be groggy, the rectal temperature was 105° F., pulse rate 100 per minute, and respiratory rate 20 per minute. She gagged continuously. A furuncle demonstrated high in the right side of the nose ruptured during the examination, and the core came out. Pain developed in lower abdomen and

hips. There was nausea, inability to retain fluids, and frequent vomiting. Chills also occurred. Blood pressure was 112/80.

A catheterized specimen showed:

Specific gravity 1.008
Albumin 2 plus
Red blood cells 0
White blood cells 30 to 40
Bacteria, many
Appearance, cloudy
Reaction, alkaline

Twelve hours after admission the patient was still unable to void; 700 c.c. urine was obtained by catheter.

Examination of a specimen of blood showed:

Hemoglobin, 12.3 Gm., or 85 per cent
Red blood cells, 4,140,000
White blood cells, 12,250
Kahn, negative
Malaria, negative
Widal, negative.

Spinal fluid showed no white or red blood cells, 81 mg. sugar; the Kahn was negative.

There were a few gram positive cocci found in the smear taken from the nose.

Penicillin, intravenous glucose and Stearn's amino acids were given.

December 27: Patient was still unable to void, and only 50 c.c. urine could be obtained by catheter. A chest x-ray showed possibly a virus pneumonia. Salyrgan with theophylline given. Blood pressure 130/68.

December 28: An x-ray of the sinuses was negative. An x-ray of the chest showed consolidation of left lobe. Intravenous fluids were increased, but there was still total suppression of urine. The non protein nitrogen was reported 64.5 mg., blood chlorides 462 mg. Blood pressure 130/60.

December 29: Penicillin decreased from 50,000 units every 2 hours to 15,000 units every 3 hours. Amino acids discontinued. Glucose 50 per cent and Hartmann's solution were started. Digitoxin was started. Some edema of the lungs with congestion developed, and also oliguria.

An unsatisfactory nerve block was done with sacral analgesia and warming of the left foot. There was a slight blood pressure fall: 150/80 to 130/60. Following the unsuccessful caudal analgesia procedure, a Touhy catheter spinal technic was carried out, with the catheter being introduced into the subarachnoid space at the level of the 12th thoracic vertebra. Metycaine, 1.5 per cent, was the analgesic drug. Blood pressure was 180/110 before injection, 116/68 after injection. During the few hours following the metycaine injections, a small increase in urine output could be seen. Two c.c. of metycaine was injected every hour and a half.

December 30: Generalized edema increased. Gallop rhythm to heart beat. Oliguria persisted. Hartmann's solution discontinued. Glucose, 5 per cent, in distilled water, 1000 c.c. every 8 hours. After obtaining a total dosage of 35 c.c. the metycaine was discontinued and pontocaine given instead. Blood pressure 190/100.

December 31: Patient still conscious but breathless, dyspneic and exhausted. She was placed in oxygen tent and the intravenous glucose was decreased to 500 c.c. every 8 hours. Coramine was given as required. Aminophyllin was given intravenously as edema continued to increase and the patient became waterlogged. All intravenous fluids were then discontinued.

Jan. 1, 1947: Kidney function tests showed considerable improvement. The 24 hour output this day was 515 c.c., as compared with 175 c.c. during the previous 24 hours. Blood pressure began gradually falling. Pulse rate was 112 and digifolin dosage was increased. Aminophyllin and 50 c.c. of 50 per cent glucose solution were given intravenously every 8 hours.

January 2: Non protein nitrogen reported 107 mg. per cent. Wangensteen suction was started because of continuous nausea and vomiting. The patient was taken out of the oxygen tent. Urine output was 1950 c.c. in 24 hours.

January 3: Urine output 3430 c.c. in 24 hours. General condition improved. Edema showed signs of decreasing. Total proteins 7 Gm. per 100 c.c. Aminophyllin discontinued; 500 c.c. plasma was tolerated. This was followed by glucose, 10 per cent, 500 c.c. in distilled water every 8 hours.

January 4: More decrease in edematous condition. Patient was improving in every respect.

January 5: Wangensteen suction removed and fluids were tolerated by mouth. Blood count showed a hemoglobin of 8.8 Gm., or 60 per cent, red blood cells 3,440,000, total protein 8.3 Gm. Examination of urine showed slight change except for 25 to 30 red blood cells.

January 6: No more pontocaine was given. Catheter remained in place. Blood pressure leveled off around 140/80.

January 7: 500 c.c. whole blood received without reaction.

January 8: Ureteral catheter removed after 10 days and 6 hours of therapy with continuous spinal anesthesia. Patient improved.

January 9: Condition showed steady improvement. Pulse 100. Light foods enjoyed. Urine output was 700 c.c. the first 24 hours following removal of spinal catheter. Non protein nitrogen reported 92.5 mg. per cent, showed daily decrease.

January 10: Patient greatly improved.

January 12: Urine output (without catheter) 2450 c.c. in 24 hours.

January 14: Intravenous fluids and penicillin discontinued. Temperature normal. Blood pressure normal.

January 15: Improvement continued. Adequate intake and output. No nausea or vomiting. No edema. Blood pressure 126/70.

CLINICAL CHARTS OF CASE 8

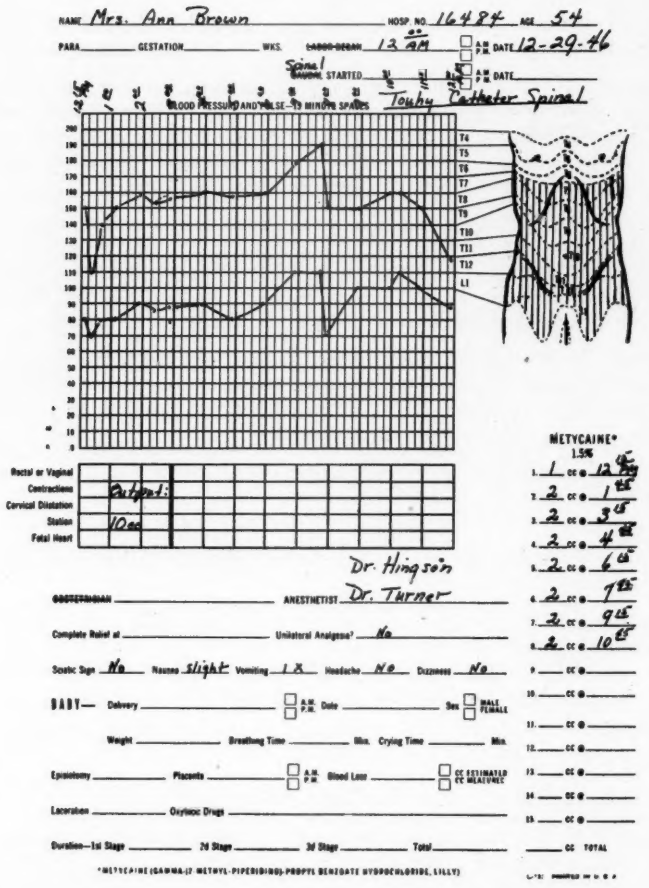


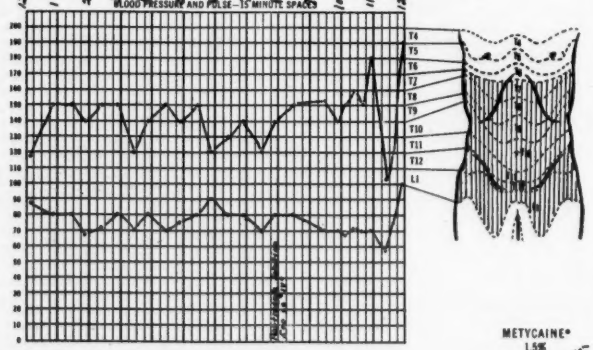
Fig. 4. Clinical charts of Case No. 8 showing the dosage schedule of continuous spinal (Touhy Catheter) anesthesia in the control of critical hypertension during prolonged overwhelming toxemia and acute glomerulonephritis accompanied by anuria for 4 days, and near fatal pulmonary edema. Note the diuresis reaching more than 4,000 c.c. of urine per day during recovery period under maintained nerve block through somatic nerve segments from the height of thoracic 4. See pages 593 to 600, inclusive.

NAME Mrs. Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 12-30-46

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal
Contractions
Cervical Dilatation
Station
Fetal Heart

Output: 30cc

METYCAINE* 1.5%

1.	2 cc	12
2.	2 cc	1
3.	2 cc	3
4.	2 cc	4
5.	2 cc	6
6.	2 cc	7
7.	2 cc	9
8.	3 cc	10
9.	3 cc	11
10.	cc	
11.	cc	
12.	cc	
13.	cc	
14.	cc	
15.	cc	
	cc	TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting ____ Headache ____ Dizziness ____

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

Metycaine Total dosage 35cc

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE LILLY)

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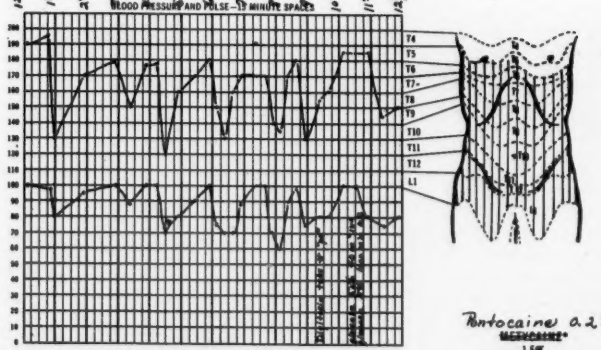
CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal
Contractions
Cervical Dilatation
Station
Fetal Heart

1 hour output: 30 cc

4 hour output: 45 cc

Pontocaine 0.2%

METYCAINE* 1.5%

1.	2 cc	12
2.	2 cc	3
3.	2 cc	4
4.	3 cc	6
5.	2 cc	7
6.	2 cc	8
7.	2 cc	10
8.	2 cc	11
9.	cc	
10.	cc	
11.	cc	
12.	cc	
13.	cc	
14.	cc	
15.	cc	
	cc	TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting ____ Headache ____ Dizziness ____

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE LILLY)

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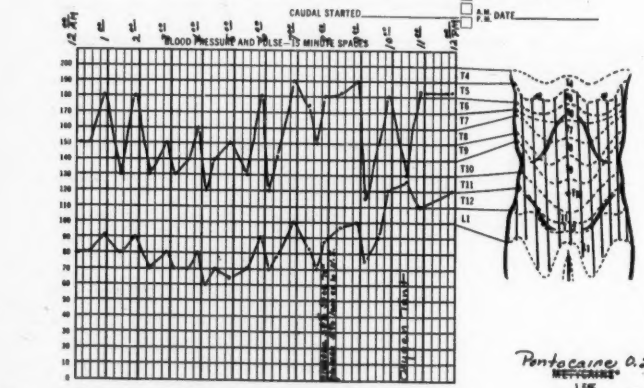
PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 12-31-46

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal
Contractions
Cervical Dilatation
Station
Fetal Heart

6 hour output:	6 hour output:
30 cc	70 cc

24 hour output: 175 cc

Pontocaine 0.2% METICAINE* 1.5%

1.	2 cc	12 AM
2.	2 cc	1 PM
3.	2 cc	2 PM
4.	2 cc	3 PM
5.	2 cc	4 PM
6.	2 cc	5 PM
7.	2 cc	6 PM
8.	2 cc	7 PM
9.	2 cc	8 PM
10.	2 cc	9 PM
11.	2 cc	10 PM
12.	2 cc	11 PM
13.	2 cc	12 PM
14.	cc	
15.	cc	
	cc	TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting ____ Headache ____ Dizziness ____

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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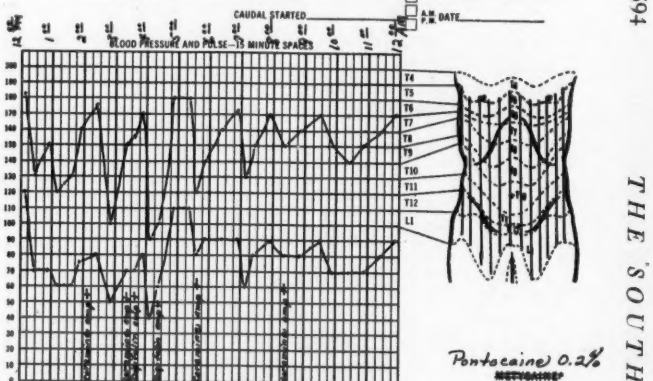
PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 12-31-46

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal
Contractions
Cervical Dilatation
Station
Fetal Heart

6 hour output:	6 hour output:
80 cc	135 cc

Pontocaine 0.2% METICAINE* 1.5%

1.	2 cc	1 PM
2.	2 cc	2 PM
3.	2 cc	4 PM
4.	2 cc	5 PM
5.	2 cc	7 PM
6.	2 cc	8 PM
7.	2 cc	10 PM
8.	2 cc	11 PM
9.	2 cc	(next page) PM
10.	cc	
11.	cc	
12.	cc	
13.	cc	
14.	cc	
15.	cc	
	cc	TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea X Vomiting X Headache ____ Dizziness ____

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

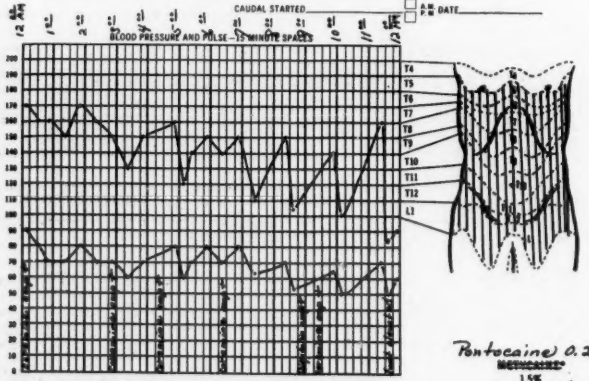
*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

NAME Mrs. Ann Brown HOSP NO 16484 AGE 54

PARA ____ GESTATION ____ WKS LABOR BEGAN ____ A.M. P.M. DATE 1-1-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



	4 hour output:	4 hour output:				
Rectal or Vaginal Contractions						
Cervical Dilatation						
Station						
Fetal Heart	180 cc	120 cc				

24 hour output: 515 cc

Pontocaine 0.2% METYCAINE* 1.5%

1. 2 cc ● 1 AM
2. 2 cc ● 2 "
3. 2 cc ● 4 "
4. 2 cc ● 5 "
5. 2 cc ● 7 "
6. 2 cc ● 8 "
7. 2 cc ● 10 "
8. 3 cc ● 11 "
9. ____ cc ●
10. ____ cc ●
11. ____ cc ●
12. ____ cc ●
13. ____ cc ●
14. ____ cc ●
15. ____ cc ●

____ cc TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea X Vomiting X Headache ____ Dizziness ____

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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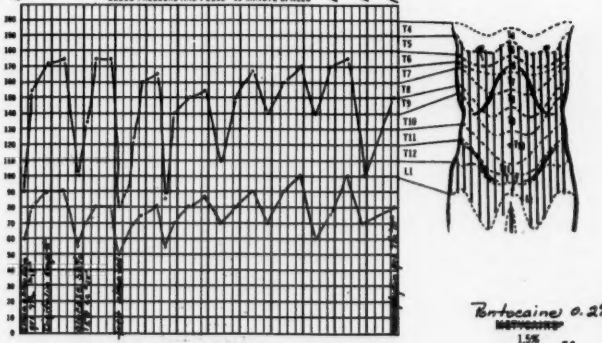
CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



	4 hour output:	4 hour output:				
Rectal or Vaginal Contractions						
Cervical Dilatation						
Station						
Fetal Heart	840 cc	480 cc				

Pontocaine 0.2% METYCAINE* 1.5%

1. 2 cc ● 1 AM
2. 2 cc ● 3 "
3. 2 cc ● 4 "
4. 2 cc ● 6 "
5. 2 cc ● 7 "
6. 2 cc ● 9 "
7. 2 cc ● 10 "
8. 2 cc ● 12 "
9. ____ cc ●
10. ____ cc ●
11. ____ cc ●
12. ____ cc ●
13. ____ cc ●
14. ____ cc ●
15. ____ cc ●

____ cc TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea X Vomiting X Headache ____ Dizziness ____

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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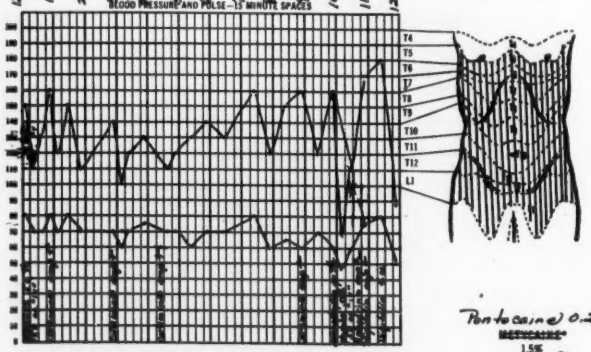
CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal												
Contractions												
Cervical Dilatation												
Station	6 hour output					6 hour output						
Fetal Heart	350 cc					900 cc						

24 hour output: 1950 cc

Pontocaine 0.2%
METYCAINE* 1.5%

1.	2 cc	1 gtt
2.	2 cc	3 cc
3.	2 cc	4 cc
4.	2 cc	6 cc
5.	2 cc	7 cc
6.	2 cc	9 cc
7.	2 cc	10 cc
8.	2 cc	11 cc
9.		
10.	1 cc	3 cc
11.	2 cc	
12.	cc	
13.	cc	
14.	cc	
15.	cc	
	cc TOTAL	

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea X Vomiting X Headache ____ Dizziness ____

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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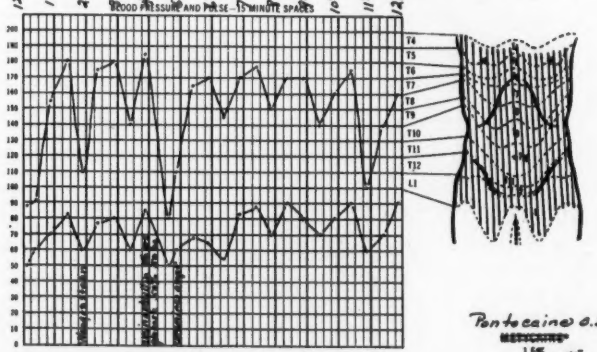
PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-2-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal												
Contractions												
Cervical Dilatation												
Station	6 hour output:					6 hour output:						
Fetal Heart	750 cc					850 cc						

Pontocaine 0.2%
METYCAINE* 1.5%

1.	1 cc	1 gtt
2.	1 cc	3 cc
3.	2 cc	4 cc
4.	1 cc	6 cc
5.	1 cc	7 cc
6.	1 cc	9 cc
7.	1 cc	10 cc
8.	1 cc	12 cc
9.	cc	
10.	cc	
11.	cc	
12.	cc	
13.	cc	
14.	cc	
15.	cc	
	cc TOTAL	

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea X Vomiting (Hiccough) Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

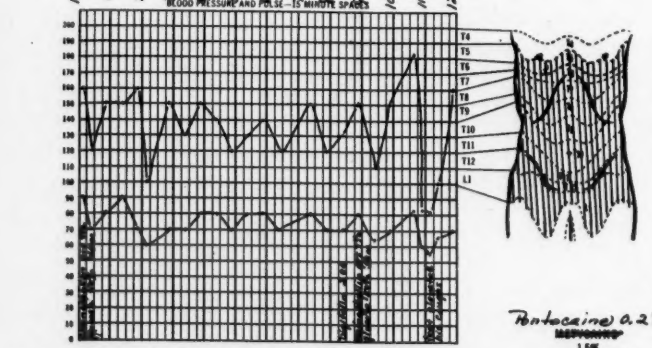
*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

NAME Mrs. Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-3-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal
Contractions
Cervical Dilatation
Station
Fetal Heart

6 hour output: 830 cc | 6 hour output: 1000 cc

24 hour output: 3430 cc

Pontocaine 0.2% DEPONOX 1.5%

1. 2 cc @ 1 PM
2. 1 cc @ 3 PM
3. 1 cc @ 4 PM
4. 1 cc @ 6 PM
5. 1 cc @ 7 PM
6. 1 cc @ 9 PM
7. 2 cc @ 10 PM
8. ____ cc @ ____
9. ____ cc @ ____
10. ____ cc @ ____
11. ____ cc @ ____
12. ____ cc @ ____
13. ____ cc @ ____
14. ____ cc @ ____
15. ____ cc @ ____

____ cc TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting Ungestor Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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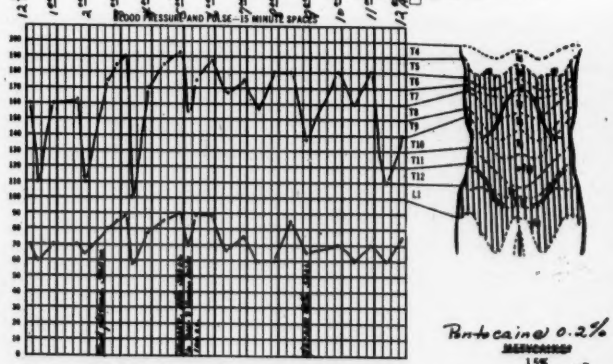
PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-3-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal
Contractions
Cervical Dilatation
Station
Fetal Heart

6 hour output: 900 cc | 6 hour output: 1100 cc

Pontocaine 0.2% METYCAINE 1.5%

1. 1 cc @ 12 PM
2. 1 cc @ 1 AM
3. 2 cc @ 3 AM
4. 1 cc @ 5 AM
5. 1 cc @ 6 AM
6. 1 cc @ 7 AM
7. 1 cc @ 8 AM
8. 1 cc @ 10 AM
9. 1 cc @ 11 AM
10. 1 cc @ 12 AM
11. ____ cc @ ____
12. ____ cc @ ____
13. ____ cc @ ____
14. ____ cc @ ____
15. ____ cc @ ____

____ cc TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting Ungestor Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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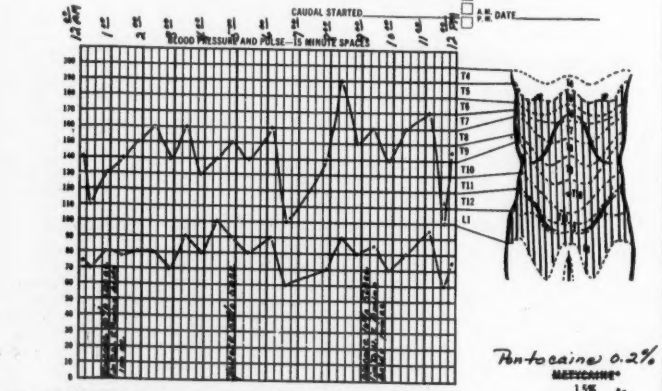
NAME Mrs. Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-4-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Pontocaine 0.2%

METYCAINE* 1.5%

1.	1 cc	2 am
2.	1 cc	3 "
3.	1 cc	6 "
4.	1 cc	8 "
5.	1 cc	11 "
6.	____ cc	
7.	____ cc	
8.	____ cc	
9.	____ cc	
10.	____ cc	
11.	____ cc	
12.	____ cc	
13.	____ cc	
14.	____ cc	
15.	____ cc	
	____ cc	TOTAL

	12 AM	1	2	3	4	5	6	7	8	9	10	11	12 PM
Rectal or Vaginal Contractions													
Cervical Dilatation													
Station													
Fetal Heart													

6 hour output: 860 cc | 6 hour output: 850 cc

24 hour output: 3710 cc

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting Wangensteen Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex ☐ MALE ☐ FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ ☐ CC ESTIMATED ☐ CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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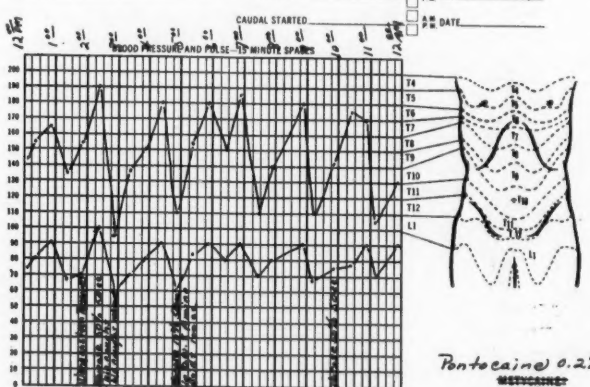
NAME Mrs. Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-4-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Pontocaine 0.2%

METYCAINE* 1.5%

1.	1 cc	1 45 am
2.	1 cc	3 35 "
3.	1 cc	3 50 "
4.	1 cc	4 10 "
5.	1 cc	6 15 "
6.	1 cc	7 15 "
7.	1 cc	9 00 "
8.	1 cc	11 00 "
9.	____ cc	
10.	____ cc	
11.	____ cc	
12.	____ cc	
13.	____ cc	
14.	____ cc	
15.	____ cc	
	____ cc	TOTAL

	12 AM	1	2	3	4	5	6	7	8	9	10	11	12 PM
Rectal or Vaginal Contractions													
Cervical Dilatation													
Station													
Fetal Heart													

6 hour output: 1150 cc | 6 hour output: 900 cc

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea Slight Vomiting Wangensteen Removed Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex ☐ MALE ☐ FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ ☐ CC ESTIMATED ☐ CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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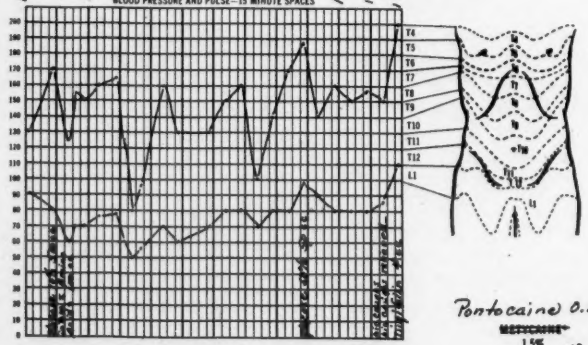
NAME Mrs. Ann Brown HOSP. NO 16487 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-5-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal		
Contractions		
Cervical Dilatation	6 hour output:	6 hour output:
Station	900 cc	1300 cc
Fetal Heart		

24 hour output: 4250 cc

Pontocaine 0.2%
METYCAINE* 1.5%

1.	1 cc	1 AM
2.	1 cc	3 cc
3.	1 cc	5 cc
4.	1 cc	7 cc
5.	1 cc	9 cc
6.	1 cc	10 cc
7.	1 cc	12 cc
8.	cc	
9.	cc	
10.	cc	
11.	cc	
12.	cc	
13.	cc	
14.	cc	
15.	cc	
	cc	TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea Slight Vomiting Slight Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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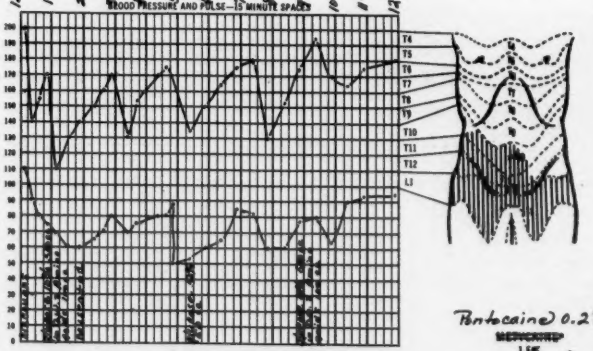
NAME Mrs Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-5-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal		
Contractions		
Cervical Dilatation	6 hour output:	6 hour output:
Station	1200 cc	750 cc
Fetal Heart		

Pontocaine 0.2%
METYCAINE* 1.5%

1.	1 cc	1 PM
2.	1 cc	3 cc
3.	1 cc	4 cc
4.	1 cc	7 cc
5.	1 cc	9 cc
6.	1 cc	12 cc
7.	cc	
8.	cc	
9.	cc	
10.	cc	
11.	cc	
12.	cc	
13.	cc	
14.	cc	
15.	cc	
	cc	TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting ____ Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

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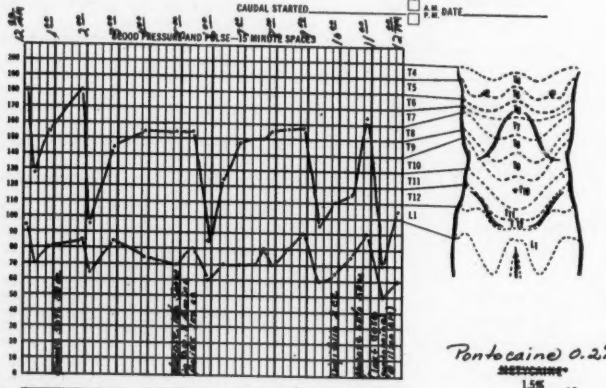
NAME Mrs. Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-6-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal																							
Contractions																							
Cervical Dilatation																							
Station																							
Fetal Heart																							

6 hour output: 1000 cc

6 hour output: 900 cc

24 hour output: 3870 cc

Pontocaine) 0.2%

METYCAINE* 1.5%

1. 1 cc @ 2 AM
2. 1 cc @ 5
3. 1 cc @ 9
4. 1 cc @ 11
5. ____ cc (test dose)
6. ____ cc @ ____
7. ____ cc @ ____
8. ____ cc @ ____
9. ____ cc @ ____
10. ____ cc @ ____
11. ____ cc @ ____
12. ____ cc @ ____
13. ____ cc @ ____
14. ____ cc @ ____
15. ____ cc @ ____

Total dosage 167 cc

____ cc TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting ____ Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

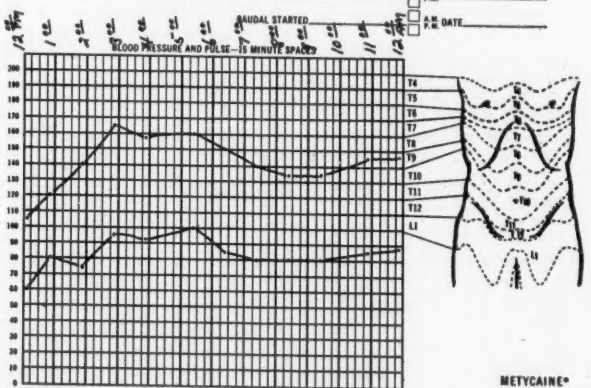
*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

NAME Mrs. Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-6-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



Rectal or Vaginal																							
Contractions																							
Cervical Dilatation																							
Station																							
Fetal Heart																							

6 hour output: 900 cc

6 hour output: 750 cc

METYCAINE* 1.5%

1. ____ cc @ ____
2. ____ cc @ ____
3. ____ cc @ ____
4. ____ cc @ ____
5. ____ cc @ ____
6. ____ cc @ ____
7. ____ cc @ ____
8. ____ cc @ ____
9. ____ cc @ ____
10. ____ cc @ ____
11. ____ cc @ ____
12. ____ cc @ ____
13. ____ cc @ ____
14. ____ cc @ ____
15. ____ cc @ ____

____ cc TOTAL

OBSTETRICIAN ____ ANESTHETIST ____

Complete Relief at ____ Unilateral Analgesia? ____

Sciatic Sign ____ Nausea ____ Vomiting ____ Headache No Dizziness No

BABY— Delivery ____ A.M. P.M. Date ____ Sex MALE FEMALE

Weight ____ Breathing Time ____ Min. Crying Time ____ Min.

Episiotomy ____ Placenta ____ A.M. P.M. Blood Loss ____ CC ESTIMATED CC MEASURED

Laceration ____ Oxytocic Drugs ____

Duration—1st Stage ____ 2d Stage ____ 3d Stage ____ Total ____

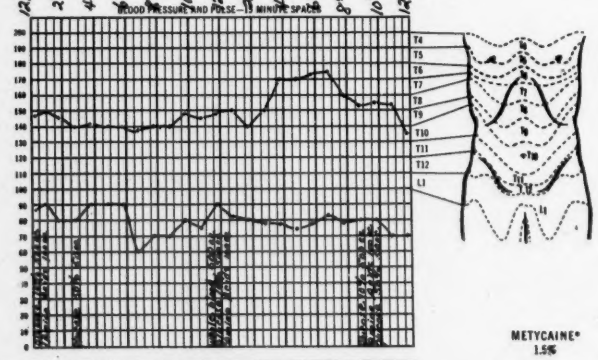
*METYCAINE (GAMMA-(2-METHYL-PIPERIDINO)-PROPYL BENZOATE HYDROCHLORIDE, LILLY)

NAME Mrs Ann Brown HOSP. NO. 16484 AGE 54

PARA ____ GESTATION ____ WKS. LABOR BEGAN ____ A.M. P.M. DATE 1-7-47

CAUDAL STARTED ____ A.M. P.M. DATE ____

BLOOD PRESSURE AND PULSE—15 MINUTE SPACES



| | 6 hour output: | 6 hr. output: | 6 hr. output: | 6 hr. output: | | |

SUMMARY RECORDS OF THERAPY WITH PROLONGED NERVE BLOCKS WITH RESULTS IN VASCULAR AND RENAL EMERGENCIES

No.	Sex	Race	Age	Diagnosis	Duration of Symptoms	Type of Nerve Block	Duration of Block	Immediate Results	Blood Pressure Fluctuations	Final Result
1.	F	C.	42	Pre- and Post-partum eclampsia, congestive heart failure, pulmonary edema, and anuria.	18 hours	Continuous catheter caudal for 6 hours; continuous Tuohy spinal for 18 hours.	24 hours	Prompt relief of pulmonary edema and dyspnea. Reduction of hypertensive crisis.	200/140 to 80/40 210/146 to 80/50 to 130/94	Recovered with adequate renal.
2.	F	C	10	Glomerulonephritis, oliguria, hypertensive crisis, pulmonary edema.	3 days	Continuous catheter caudal for 25 hours.	18 hours	Immediate cessation of convulsions; increased urinary output, return of consciousness.	200/180 to 140/90 and maintained in this plane for duration of block.	Complete recovery.
3.	F	C	11	Acute glomerulonephritis, oliguria, pulmonary edema.	5 days	Continuous catheter caudal.	Well-established for 1 hour; subsequent failure.	Immediate improvement maintained only 2 hours; then progressive hypertensive crisis.	238/190 to 178/126 in 25 minutes; then rose in 1 hour to higher levels.	Died 30 hours later with extreme hypertension and anemia.

4.	M W 13	Uremia with 8 convulsions, congestive heart failure; deepening coma; anuria for 6 days following sulfa compound therapy for pneumonia.	Pneumonia and 6 days' anuria.	Continuous catheter.	12 hours	Immediate improvement in respirations with prompt beginning of urinary output; return of consciousness and cessation of convulsions.	148/100 to 115/70	Recovered
5.	M W 46	Pneumonia Overwhelming toxemia from postoperative peritonitis; anuria for 4 days; uremia.	Acute appendicitis, peritonitis, anuria and deepening uremia for 3 days.	Continuous catheter caudal.	3 days	Early improvement with slightly increased urinary output for 3 days of 40 to 60 c.c. to 100 c.c. per day.	180/120 to 140/96	Died 74 hours after block started.
6.	M W 58	Postoperative paralytic ileus anuria, uremia following inadvertant incision of colon during herniaplasty.	2 days	Continuous catheter caudal.	2 hours	Immediate audible peristalsis in previously silent abdomen with development of critical hypertension.	146/88 to 100/60 to 60/40 to 120/70 to 0/0	Extremely toxic patient responded early and died 2 hours later.
7.	M W 64	Postoperative anuria and uremia.	8 days	Continuous catheter caudal.	68 hours	Control of convulsions and extreme hypertension and headache.	192/104 to 140/88	Died in progressive uremia with absolute anuria.

SUMMARY RECORDS OF THERAPY WITH PROLONGED NERVE BLOCKS WITH RESULTS IN VASCULAR AND RENAL EMERGENCIES

No.	Sex	Race	Age	Diagnosis	Duration of Symptoms	Type of Nerve Block	Duration of Block	Immediate Results	Blood Pressure Fluctuations	Final Result
8.	F	W	54	Acute glomerulonephritis and anuria complicating cavernus sinus thrombosis; congestive heart failure; pulmonary edema; uremia.	Ill for 12 days; anuria and coma 5 days.	Continuous Touhy catheter spinal	10 days 6 hours Spinal anesthesia from T6 to S5.	Control of 114 episodes of critical hypertension; re-establishment of diuresis of 3,000 c.c. per day.	196/120 to 94/60	Complete recovery.
9.	F	W	26	Congestive heart failure, eclampsia with convulsion initiating maintained semi-coma; placenta previa with 1000 c.c. hemorrhage.	36 to 50 hours, extreme dyspnea.	Continuous catheter caudal for 24 hours; continuous Touhy spinal for 72 hours.	24 hours 72 hours	Dramatic clearing of pulmonary edema and cyanosis; return of consciousness; anesthesia for cesarean section.	180/110 to 86/45 194/116 to 100/60	Complete recovery with living premature baby.
10.	M	C	8	Acute glomerulonephritis; hypertensive crisis; anuria.	2 days	Continuous catheter.	6 hours	Immediate reduction in hypertension from 186/85 to 145/96 to an immediate return to 160/85. Adequate urinary output did not begin until block was discontinued.	186/85 to 145/96 to 160/85	Recovered

11.	M W 13	Acute glomerulonephritis, pulmonary edema, uremia, coma.	4 days	Continuous catheter caudal for 3 days; Touhy spinal for 6 hours.	3 days, 6 hours.	Urinary output of 20 c.c. in 10 minutes after block. Gradual increase to 1000 c.c. last day of life.	160/96 to 110/85	Early improvement but progressive anoxia due to fall in RBC below 1,000,000. Died.
12.	F C 26	Toxemia, anemia, blood transfusion, reaction from incompatible blood; anuria.	18 hours		31 hours	No change in condition.	146/86 to 124/80	Died in 31 hours with progressive red cell destruction.
13.	F W 27	Toxemia; Rh incompatibility with second baby; cervical dystocia with laceration of cervix and profuse hemorrhage at birth of baby; blood transfusion reaction; jaundice, oliguria.	22 hours of jaundice, anoxia, and oliguria.	Touhy continuous spinal.	3 days	Improvement in urinary output to 300 c.c. daily, but increasing uremia and anemia, regardless of therapy.	146/84 to 110/60	Died in 3 days following initial improvement.

SUMMARY RECORDS OF THERAPY WITH PROLONGED NERVE BLOCKS WITH RESULTS IN VASCULAR AND RENAL EMERGENCIES

No.	Sex	Race	Age	Diagnosis	Duration of Symptoms	Type of Nerve Block	Duration of Block	Immediate Results	Blood Pressure Fluctuations	Final Result
14.	F	W	14	Eclampsia and convulsions following increasing edema progressing to anasarca, tremendous edema of vulva with blister formation; pulmonary edema; oliguria.	Several days.	Touhy continuous catheter spinal.	48 hours	Diminution of edema; slight increase in urinary output.	172/98 to 116/84	Recovery following Cesarean section under same block 24 hours later; block continued as prophylaxis for another 24 hours.
15.	F	W	58	Saddle embolus of aorta complicating auricular fibrillation congestive heart failure, pulmonary edema and hypostatic pneumonia.	6 hours	Continuous catheter caudal for 3 days with administration of 37,-260 mg. of metycaine for extreme pain.	3 days	Immediate relief of agonizing pain with slow restoration of circulation one entire lower extremity and improvement to mid calf in other.	148/68 to 126/60	Immediate improvement in circulation and in general condition for 3 days; then sudden death after heart became compensated and threw out another massive embolus.

16.	M W 14	Popliteal thrombosis complicating fracture of tibial epiphyseal junction extending into knee joint.	4 days of painful swelling of leg in cast then anoxic cyanosis to knee and heat loss to mid-thigh.	Continuous catheter caudal.	8 days	Immediate relief of pain and slow warming of entire leg into ankle with alleviation of anoxic cyanosis.	128/88 to 116/80	Recovery after above ankle amputation on 10th day.
17.	F C 36	Chronic nephritis with hypertensive heart disease; pulmonary edema; oliguria uncontrolled headache; toxemia of late pregnancy high multiparity.	Several months.	Touhy continuous catheter spinal, for 39 hours.		Immediate relief of headache of week's duration, which did not return; improved vision but vasomotor collapse requiring vasopressor drugs and fluids.	268/134 to 60/40 to 154/90 where patient was maintained in improved state for 24 hours and then hysterotomy under same block.	Recovery with blood pressure reduced to 180/90.

Cases Number 18 to 35 include 18 severe and moderately severe eclamptics with convulsions and various other toxic manifestations who were treated from 8 to 190 hours with continuous catheter caudal and Tuohy continuous spinal therapeutic block. These are in preparation for a separate report and analysis. There were only 2 deaths among them.

Among these 35 seriously ill and pre-moribund patients there were 8 deaths in the described cases and 2 deaths among the last group of eclamptic patients. The deaths in Cases 6 and 7 were probably hastened by the block. Unquestionably, the prompt recovery of several patients with acute pulmonary edema after all of the usual forms of therapy had failed could be accurately ascribed to the block. While the increase in urinary output in those cases with anuria seemed to be associated with the block of the sympathetic fibers to the level of thoracic 6, much more investigative work needs to be done with experimental renal clearance studies under various levels of block.

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OPPORTUNITY AT THE DOOR OF SURGERY DEPARTMENTS OF MEDICAL COLLEGES

The current years are witnessing a steady—and in some particular fields, a rapid—change in the basis of progress in surgery. This basis, from which all progress must start, is the body of knowledge which constitutes the theory of surgery. From it all rational surgical practice proceeds.

For centuries, surgical theory has been extended and modified through the judicious innovations and careful observations of leaders in the field. It has represented the accumulated "Art" of many keen minds, the composite judgment resulting from thousands of "trials and errors." This body of knowledge is transmitted from one generation of surgeons to the next through books and periodicals and by personal instruction. As is the case with all "Art," however, the success with which the surgical theory may be translated into surgical practice depends upon the skill, the perseverance, and, eventually, the developed judgment of the novitiates in surgery.

As the relations between surgery and the basic sciences of pathology, physiology, chemistry, and anatomy have become better understood and as these sciences, in turn, have become more precise and "scientific" in their content and method, the theory of surgery has become somewhat more "scientific" in its turn. To call knowledge "scientific" is to imply that it may be stated in precise quantitative terms. Such knowledge may be transmitted to another and

may be given practical application with minimal dependence upon the skill and judgment of the novitiate.

It is characteristic of scientific knowledge that it is gained by experiment rather than by observation or cumulative experience. It is obvious that it is highly important to surgery that as much as possible of its theory shall be based on scientific knowledge. Such knowledge may be transmitted accurately through publications and personal instruction and, consequently, may be put to use widely with a maximum degree of safety.

Scientific knowledge is gained by the use of the experimental method only, however. "Experimental method," in turn, requires rigorous control so that results obtained may be exact, measurable, and unambiguous. The use of this technic requires resources far beyond those of a single surgeon. In personnel alone, not only a surgeon with much of his energy available for research is required but also technicians with unusual skill are necessary and consultation or even participation by specialists in the basic sciences. Frequently there may be needed also expensive equipment and large numbers of animals that must be maintained in good health under experimental conditions. Housing for all this is necessary. In other words, the accumulation of scientific knowledge in the field of surgery is an institutional team-work job. There are a few privately owned or endowed "clinics" that support such efforts. In general, however, the opportunity to advance the practice of surgery through the use of experimental surgery is at the door of the department of surgery in each college of medicine. It is there that the nucleus of the necessary personnel may be found. It is under the aegis of the college also that the necessary financial support may be provided or assembled.

The collegiate department of surgery has a further opportunity to advance the practice of surgery in a way which is secondary to research but is still highly important to the specialty. When research has developed and published an advance in practice, the procedures should be checked experimentally before they are applied widely. College staffs are most likely to be equipped to repeat and check the experiments and to introduce the new procedure into the college area when it has been proved and when the staff has acquired some familiarity with the technic involved.

The alert Department of Surgery will devote itself more and more to experimental surgical research as the resources available to it permit and also to the introduction of surgical advances into the college area after they have been checked carefully by experimental tests.

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